INTERAVIA

WORLD REVIEW OF AVIATION AND ASTRONAUTICS

Price of this issue —

U.S.A.:	$ 1.00
British Isles:	4/6
South Africa:	5/6
Rhodesia:	5/6
Switzerland:	Fr. 3.50
Netherlands:	Fl. 2.80
Denmark	Cr. 6.25
Germany:	DM 3.50
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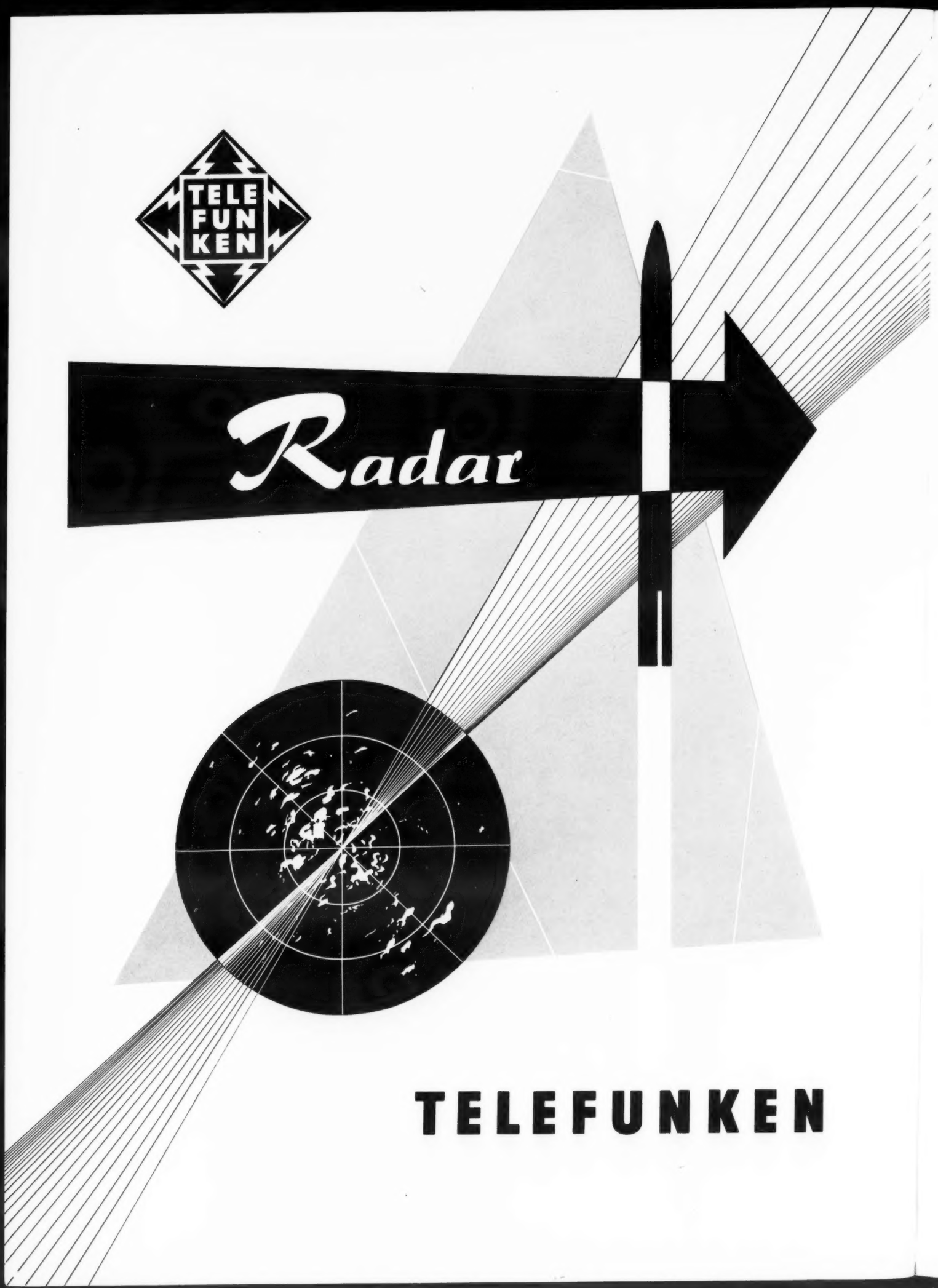
IN THIS ISSUE

Air Freight 1959

The Anti-Missile Missile—A Myth?

VOLUME XIV

No 2/1959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Volume XIV

INTERAVIA

February 1959

WORLD REVIEW OF AVIATION AND ASTRONAUTICS

AIR FREIGHT 1959

Finding the Key to the Air Freight Market 143
Aboard a KLM Freighter . . . . . P. HAUSHEER, GENEVA 145
European Air Freight without Illusions 150
Air Freight in the United States 152
The Aircraft for Freight Operations 156
Argosy & Co. 163
Progress in Pictures 166
Rockets, Missiles and Space Vehicles 168
The Anti-Missile Missile—a Myth ? . . . . . E. BURGESS, LOS ANGELES 170
Canada's Aviation, 1909-1959 . . . . . R. WILLMOT, DON MILLS 173
Lucerne, a Centre of the Aircraft Industry 175
Telecommunications and Electronics 187
Boost Gliders and Atmospheric Entry . . . . . A. EGGERS, MOFFETT FIELD, CALIF. 188
Recent Products of the Equipment Industry 190
What's in the Air ? 192
Deadline Notes 115
U.S. Defence Policy for Fiscal 1960 125
New York Finance Notes . . . . . S. HERSHEY, NEW YORK 126
International Meetings and Conferences 126

FRONT COVER: Loading cargo aboard a KLM Royal Dutch Airlines *Super Constellation.*

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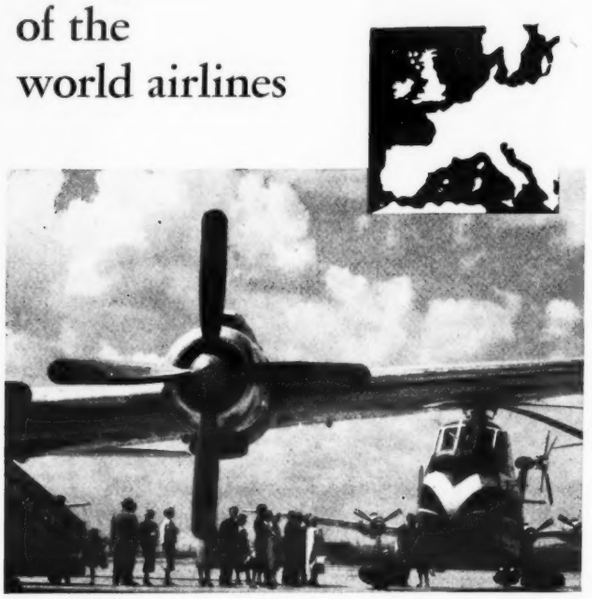

THE HELICOPTER, SYMBOL OF THE NEW EUROPE

The European community is in the making. On January 1st, 1959 a Common Market went into operation between France, Germany, Italy, Luxembourg, the Netherlands and Belgium.

Sabena's helicopter, which lands in the very heart of Western Europe's major cities and provides the fastest and most practical connections between them, has become the symbol of the new Europe.

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For six months last year, the Brussels Universal and International Fair was the great meeting point for men of all nationalities. Sabena's helicopters constantly flew over the Fair grounds, drawing permanent attention to Belgium's aviation during this great demonstration of international cooperation.

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803, National Press Bldg., Washington 4, D.C.
James C. Galloway, 6535 Wilshire Blvd., Los Angeles 48, Calif.

Distributors :

Austria Morawa & Co., Wollzeile 11, Vienna I
Canada Wm. Dawson Subscription Service Ltd., 587 Mount Pleasant Road, Toronto 12, Ont.
Edward Company Regd., P.O. Box 98, Station Delorimier, Montreal P.Q.
Finland Akateeminen Kirjakauppa, Keskuskatu 2, Helsinki
Rautatiekirjakauppa Oy, Köjdenpunojank 2, Helsinki
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Norway A/S Narvesens Litteraturtjeneste, Postboks 115, Oslo
Uruguay Humanitas, Colonia 883, Montevideo

Advertising Department, Publishing and Editorial Offices, Subscription Department :

Interavia S.A., 6, Corraterie, Geneva. Telephone: 25 42 34 (five lines). Cables and Telegrams: Interavia-Geneva. Teleprinter: 22 122. Postal Cheque Account: Geneva I 5380.

Annual Subscriptions : U.S.A. and Canada, U.S. $9.00; United Kingdom and Eire, £2.12.6; Commonwealth, £2.12.6; Switzerland, 32.— fr.; Austria, 190.— sch.; Belgium, 370.— fr.; Denmark, 55.— kr.; France, 3500 Fr. fr.; Germany, 32.— DM; Holland, 28.— fl.; Italy, 4640.— L. it.; Japan, U.S. $9.00; Latin American countries, U.S. $9.00; Norway, 57.— kr.; Spain, 360.— pts; Sweden, 40.— kr. All other countries, U.S. $9.00.

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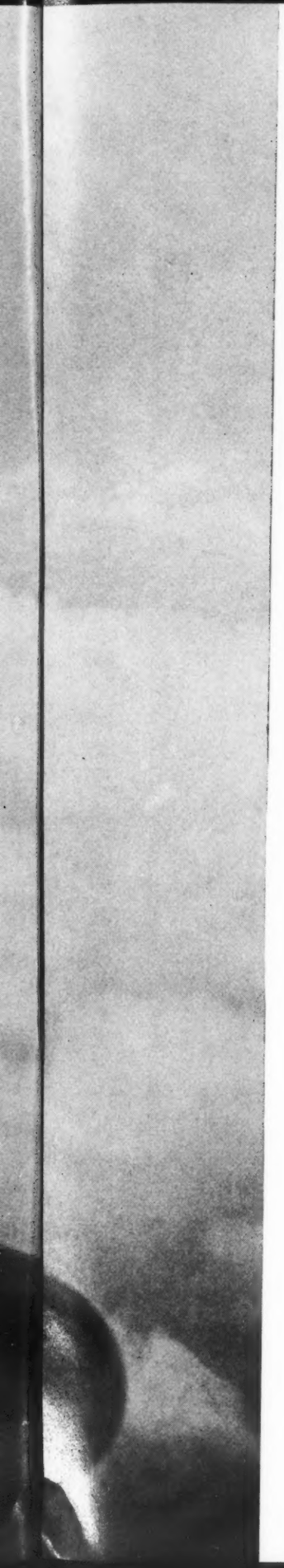

PROTEUS 705 SERIES ACHIEVES

2,000 HOURS

IN UNDER TWO YEARS' SERVICE

Bristol Proteus first entered airline service less than two years ago. Overhaul life on the 705 series has now reached 2,000 hours—a rate of increase never before achieved by any other engine, piston or gas turbine

No engine of comparable power in service today has an overhaul life that even approaches this length. Annual engine overhaul costs for BOAC's Britannia 102 aircraft have now been cut by 75% since the aircraft went into service.

Continued development, even lower fuel consumption. Further increases will give Proteus even longer overhaul life, entailing even lower operating costs. In addition, new versions of this engine—which already has a lower specific fuel consumption than any other gas turbine in civil or military use—are now giving even more power at an even lower specific fuel consumption.

Over 2½ million miles a month in world service. Every day, all over the world, Proteus-powered Britannias fly more than 80,000 miles (2½ million miles a month), carrying passengers in quiet, speedy luxury, carrying a great variety of freight loads, and bringing profit to operators.

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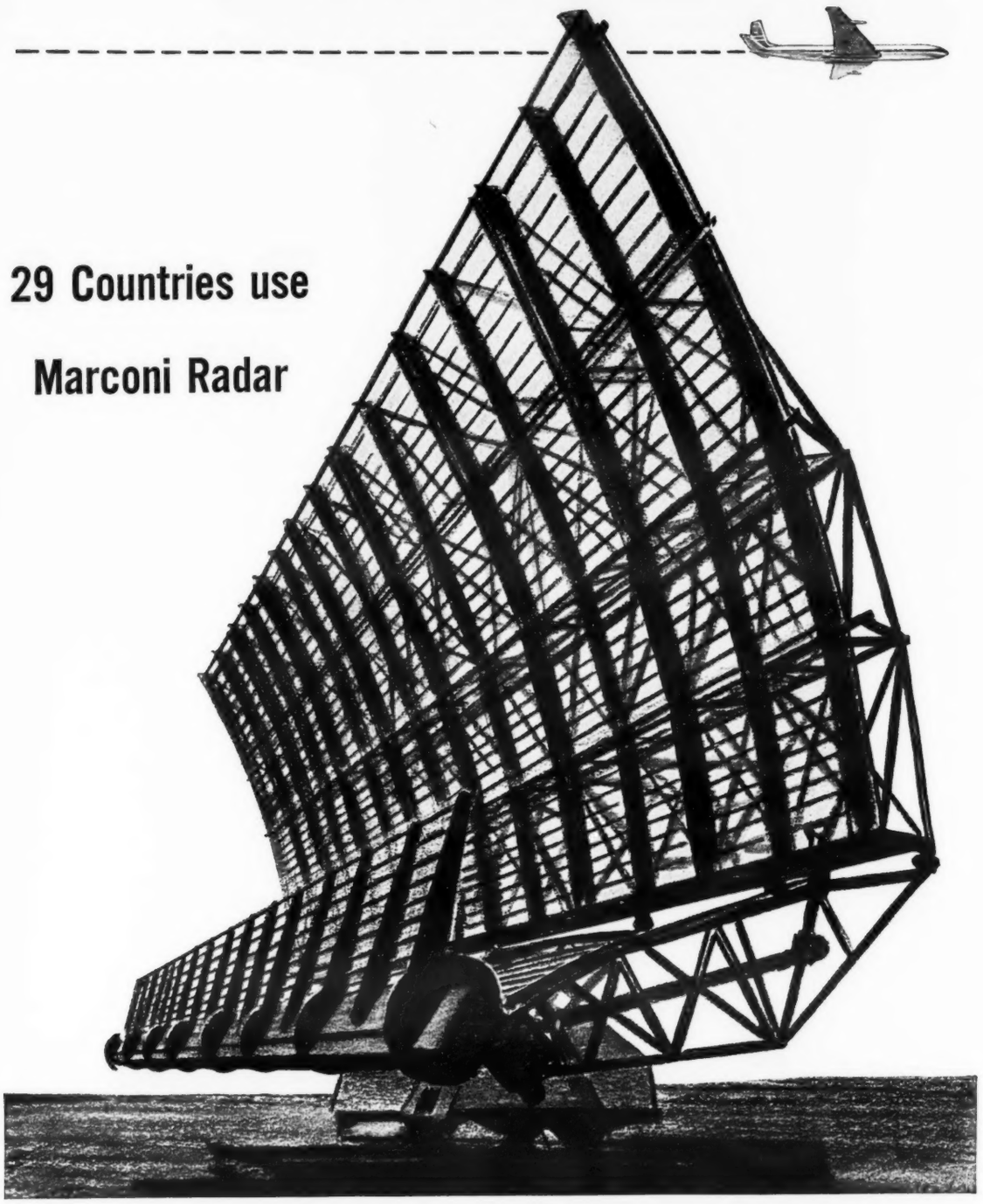
ENGINES LIMITED

Marconi in Radar



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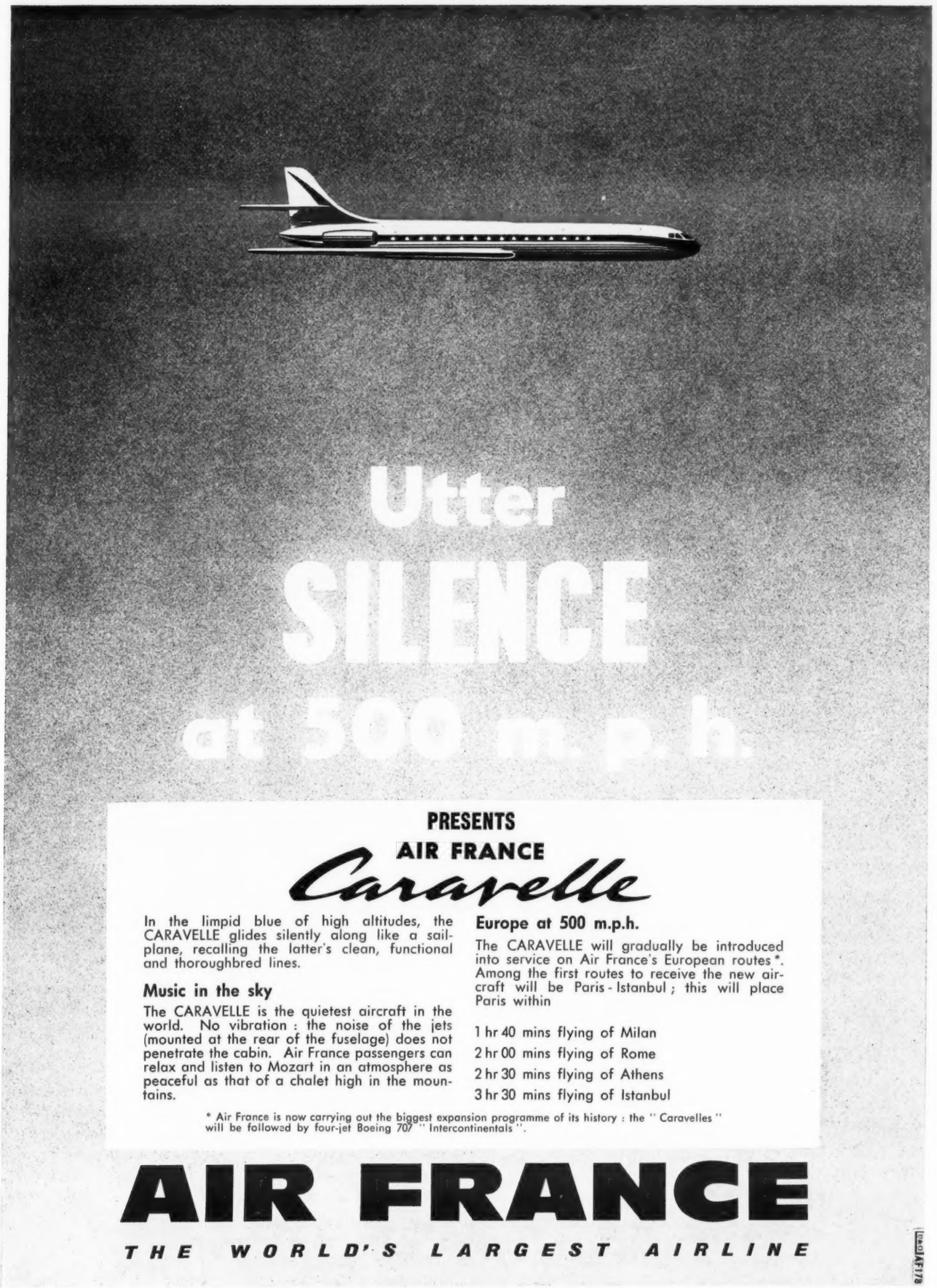

PRESENTS

AIR FRANCE

Caravelle

In the limpid blue of high altitudes, the CARAVELLE glides silently along like a sailplane, recalling the latter's clean, functional and thoroughbred lines.

Music in the sky

The CARAVELLE is the quietest aircraft in the world. No vibration : the noise of the jets (mounted at the rear of the fuselage) does not penetrate the cabin. Air France passengers can relax and listen to Mozart in an atmosphere as peaceful as that of a chalet high in the mountains.

Europe at 500 m.p.h.

The CARAVELLE will gradually be introduced into service on Air France's European routes *. Among the first routes to receive the new aircraft will be Paris - Istanbul ; this will place Paris within

1 hr 40 mins flying of Milan
2 hr 00 mins flying of Rome
2 hr 30 mins flying of Athens
3 hr 30 mins flying of Istanbul

* Air France is now carrying out the biggest expansion programme of its history : the " Caravelles " will be followed by four-jet Boeing 707 " Intercontinentals ".

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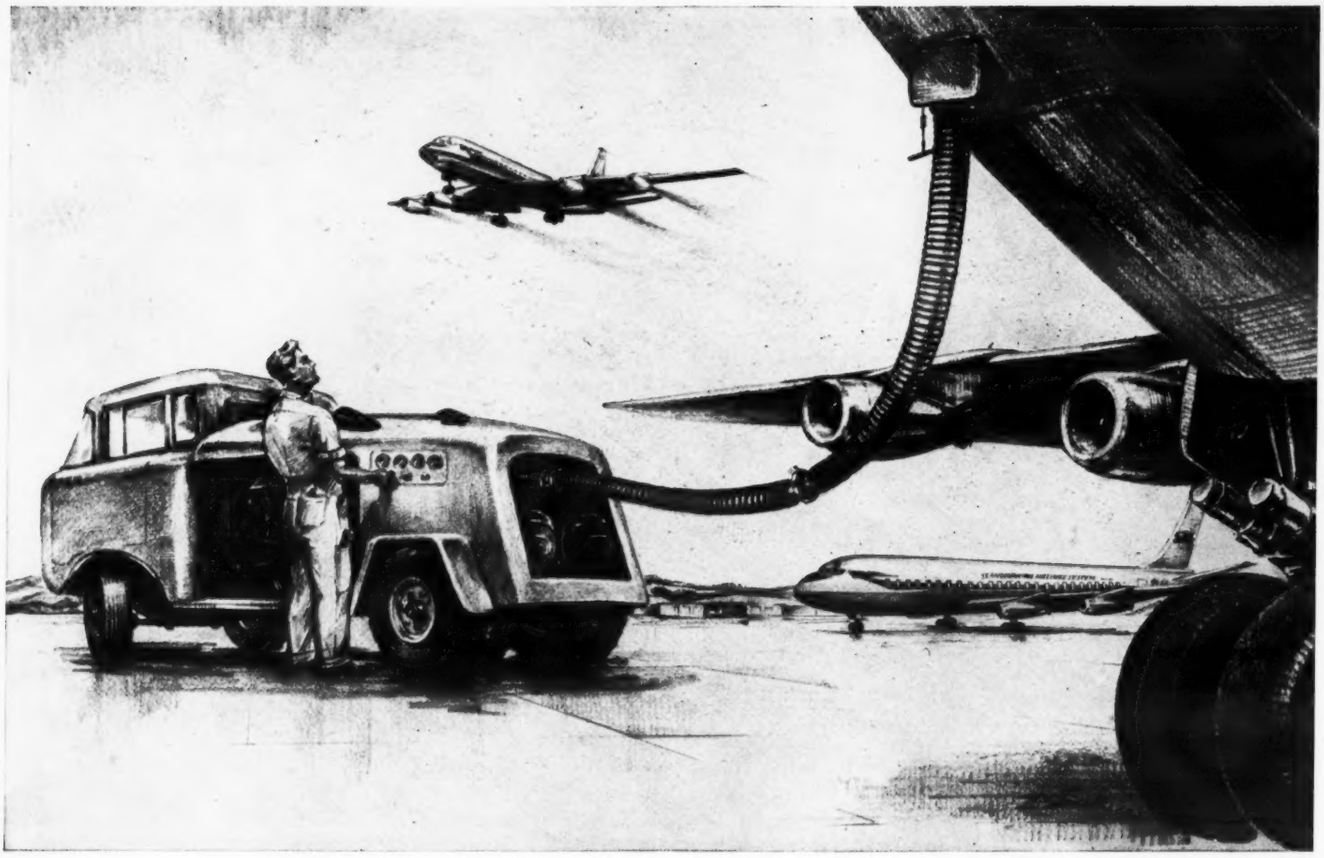

SAS chose the 'Air Partner'

Scandinavian Airlines System will use 10 Atlas Copco 'Air Partner' compressors to service their fleet of DC-8 jet airliners

STARTING · AIR CONDITIONING · DE-ICING

The Air Partner is a surge-free rotary screw compressor of the Lysholm type designed for starting, air conditioning and de-icing all jet and turbo-prop airliners having air turbine starters.

A SUCCESSFUL COMBINATION

Atlas Copco, the world's largest organisation devoted exclusively to the manufacture of compressed air equipment, combined aeronautical expertise with compressor know-how to produce this multi-purpose unit.

STARTING

The Air Partner delivers a continuous flow of warm, oil-free air to turn the engine over constantly thus eliminating mis-starts.

AIR CONDITIONING

The Air Partner becomes an air conditioning unit by merely flicking the appropriate switches and pressing a button, a matter of seconds.

DE-ICING

A special mouthpiece attached to the air hose enables the wings and fuselage to be 'sprayed' with warm air. Removal of ice and sleet from windshields, wing leading edges, and air intake lips is achieved by using the ordinary de-icing outlets of the aircraft.

SIMPLE MAINTENANCE

The Air Partner has no wearing parts. It consists of two screw rotors which intermesh but never touch one another or the casing. 10,000 hours is the normal period between overhauls for screw compressors of this type.

Maintenance operations can be carried out by airline personnel anywhere in the world or through the Atlas Copco sales and service organisation established in 90 countries.

TWO MODELS

Air Partner M-3 consists of two identical units, each including a compressor connected to a standard petrol or diesel engine, for starting, air conditioning, de-icing and checking auxiliary systems, Air Partner M-2 consists of one rotary screw compressor connected to a standard petrol or diesel engine for starting and limited air conditioning.

THE *Atlas Copco* AIR PARTNER

A contribution to the jet age of air travel

Contact your local Atlas Copco company or agent or write to Atlas Copco AB, Stockholm 1, Sweden

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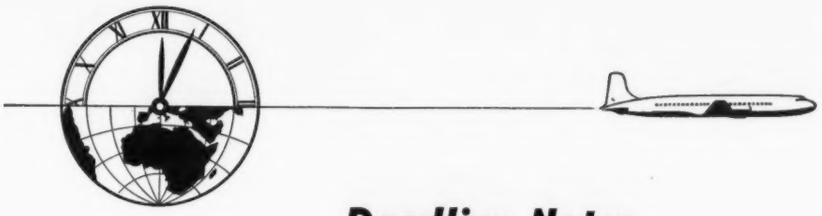


Deadline Notes

France's civil aviation budget figures for 1959 show that operating credits will increase from 20,800,000,000 French francs in 1958 to approximately 26,700,000,000 fr. For capital investments, credits will go up from 16,800,000,000 francs to nearly 20,000,000,000 francs, and commitments for a further 22,500,000,000 fr. (15,600,000,000 francs in 1958) will be authorized. In Metropolitan France, investments totalling approximately 4,000,000,000 francs are envisaged for the modernization of airports and air traffic control facilities (in particular, Marseilles and Nice). This does not include the cost of modernizing the two airports in the Paris area which alone will require a special credit of about 14,500,000,000 francs this year. 1,770,000,000 francs are earmarked to provide more VOR installations. 665,000,000 francs will be allocated to the meteorological services which will be called upon to perform new tasks in the jet age. 8,800,000,000 francs (6,700,000,000 in 1958) are earmarked for the improvement of airports, and a total of 436,000,000 francs will be invested in telecommunications facilities, 1,164,000,000 francs in air traffic control and 585,000,000 in meteorological services in French overseas territories. A total of 7,000,000,000 francs (4,800,000,000 in 1958) is allocated for subsidies towards prototype construction, covering the *Caravelle*, the *Super Alouette* and the Breguet 941. In addition, subsidies are provided for the development of radio-electrical equipment for air navigation purposes. 400,000,000 francs (100,000,000 in 1958) will purchase new training equipment, and 250,000,000 francs are provided for the acquisition of aircraft (140,000,000 francs last year). Contributions to the cost of training operations are up 50,000,000 francs over last year's figure.

●

Deutsche Lufthansa's Munich-London route was added to the company's *Viscount 814* services on February lst, 1959. On March lst, the company's *Super Constellation* flights to Spain will also be replaced by *Viscount 814* services. The Hamburg-Rome route has been flown with *Viscounts* since November 30th, 1958.

●

The British Airline Pilots Association has submitted a claim for a pay increase for BOAC pilots on jet aircraft—the *Comet 4* and the Boeing 707. The present annual salary of BOAC jet pilots is about £4,000. About 80 pilots are involved.

●

British European Airways and Swissair have agreed to operate their passenger and cargo services between the United Kingdom and Switzerland in pool. The agreement will come into effect on April 1st with the introduction of summer schedules. Bookings will be handled by each company separately.

●

The Italian aircraft industry's programme for 1959 has as its main items the production of the Fiat G.91, for which the principal sub-contractors are Piaggio and Siai Marchetti, and construction of the MB.326 by Aeronautica Macchi. The Italian Air Force is expected to entrust Aerfer, Fiat, Macchi, Piaggio and Alfa Romeo with the overhaul of its aircraft and engines. Fiat will probably begin production of Bristol *Orpheus* engines destined for the G.91. Agusta is building various versions of the Bell 47, mainly for export. Agusta and Fiat are constructing two new helicopter prototypes, while the AZ.8-L four-engined commercial transport is continuing its flight tests. The Air Force is planning to restrict research contracts to those companies engaged in research and development work in accordance with specifications laid down by NATO or the Three Power Arms Pool. A few prototypes of light aircraft will be built by craftsmen or amateurs. Active discussions are in progress with other countries (USA, France, Britain) to determine the conditions under which the Italian aircraft industry could participate in some joint programmes. These would help to tide over the next few years when military contracts are likely to be scarce. The Air Force is undertaking a reorganisation programme which will involve the adoption of guided weapons and fundamental changes in the whole Air Force structure.

●

Società Aeronautica Italiana (Ing. A. Ambrosini & Co., Milan) has authorized Raab Flugzeugbau GmbH — the company which was re-established in Cologne last August — to manufacture the Ambrosini F.7 *Rondone II* four-seat sports and touring aircraft under licence. At the same time, Ing. Antonius Raab, Manager and main proprietor of the former Raab-Katzenstein Flugzeugwerke, Kassel, was appointed General Representative of Società Aeronautica Italiana. Raab will also build the de Bernardi *Aeroscooter* under licence and be responsible for certain export sales of this model. Both Colonel Mario de Bernardi (designer of the *Aeroscooter*) and Dr. A. Ambrosini are directors of the new Raab Flugzeugbau GmbH. Pending the training of the necessary personnel, three *Rondone II* aircraft will be built initially. Subsequently (probably in the early summer of this year) it is planned to construct a batch of ten. At the same time, ten *Aeroscooters* will also be built. Ing. Raab eventually intends to revive production of the *Grasmücke* light aircraft — a very successful model formerly built by Raab-Katzenstein Flugzeugwerke.

●

Telefunken, of Ulm, has received an order from the Civil Aeronautics Administration for the supply of two PAR-2 precision approach radars to India, for installation at Bombay and New Delhi airports. Earlier CAA orders to Telefunken covered the delivery of ASR-3 surveillance radars to a number of international airports.

●

Etudes et Fabrications Aéronautiques has been awarded a contract by the Belgian Air Force for rescue kits with back-type parachute and chrono-barometric release mechanism to be used on F-84 and F-84F aircraft. Two years ago, EFA received an order to supply manual-release parachutes for Belgian airborne troops. Last year these units adopted the EFA automatic-release parachute as basic equipment.

●

Cessna Aircraft Company is organizing a demonstration of its models at Nice Airport at the end of February. The aircraft to be presented are Models 140 and 172, the 180 *Skylane* and the Model 310C twin-engined aircraft. Cessna sales representatives from various European countries will attend the demonstration.

●

The U.S. Navy has awarded a $31,400,000 contract to Convair (Pomona) Division of General Dynamics Corporation for production of an advanced version of the *Terrier* guided missile (solid-propellant engine + solid booster ; beam guidance). The new missile will incorporate improved guidance features and substantial improvements in coverage over the present *Terrier*. It is intended for the same surface-to-air use as the version which is now operational.

●

Universal-Cyclops Steel Corporation is now constructing a pilot plant known as IN-FAB (or inert fabrication) for the fabrication of refractory and reactive metals. A prime contract for the construction of the new plant was awarded to the corporation by the Industrial Planning Division of the U.S. Navy Bureau of Aeronautics. It totalled approximately $3,000,000. In 1958 Universal-Cyclops created a Refractomet Division to be devoted exclusively to the development and production of refractory and reactive metals, and the IN-FAB plant will be built under its direction.

●

A NATO communiqué has revealed the names of the European companies which may be called upon to jointly manufacture certain American guided weapons. The conditions under which these missiles for anti-aircraft defence could be built jointly by several West European countries have been studied by a group of industrialists designated by their respective governments: Ateliers de Construction Electrique de Charleroi for Belgium, Telefunken for the German Federal Republic, Finmeccanica for Italy, Philips for the Netherlands and Compagnie Thomson-Houston for France. Within the framework of the industrial organization envisaged, Compagnie Thomson-Houston may be entrusted with the coordination of production.

●

Major General Ben I. Funk, Air Materiel Command Ballistic Missiles Manager, recently confirmed to *Interavia's* West Coast Correspondent that the *Titan* ICBM programme would not be cut back, but that the *Titan* was being rushed " as rapidly as possible ". It is reported that President Eisenhower made the decision personally to continue the *Titan* project after touring The Martin Company's Denver plant for the first time. According to General Funk, more than 50 percent of the almost 400 major subcontractors in the U.S. ballistic missile programme are located in Southern California.

●

Grumman Aircraft Engineering Corporation is expecting a $22 million follow-on contract to produce the S2F-3 anti-submarine aircraft, according to an announcement issued by the Long Island firm. The Navy has submitted a notice of award to Grumman. The new contract follows an $11.6 million production order for the aircraft awarded to Grumman by the Navy last May. The carrier-based S2F-3 is a new version of Grumman's S2F-1 *Tracker,* an anti-submarine aircraft now operational with Navy fleet units.

The U.S. Navy is cutting back its goal of major new aircraft carriers to 12 in operation by 1965, instead of 15, for lack of funds. According to a report from Washington, it is expected that work on a second nuclear-powered carrier will be postponed for the second year. The *Enterprise,* now under way, will cost about $314 million. The ship will be handed over to the Navy in 1961. Navy officials said plans were also affected by changing designs in fighter-bombers which would end the need for carrier runways longer than the 700-foot-plus current maximum.

●

Bristol Airplane Co. of Canada is being reorganized in preparation for a major new sales offensive in the Canadian market. A new company has been formed, Bristol Aero Industries Ltd. and the three Canadian subsidiaries, Bristol Aero Engines (Western) Ltd., Vancouver, Bristol Aircraft (Western) Ltd., Winnipeg and Bristol Aero Engines Ltd., Montreal, have become divisions of it. Bristol Airplane Co. of Canada remains as a holding company forming the direct link with the U.K. parent company. R.J. Reynolds is President of Bristol Aero Industries Ltd. Aims of the new sales offensive are to get into the rocket and small missile field ; to win a larger share of the overhaul and maintenance market and to diversify some of the manufacturing facilities now held into less vulnerable non-defence fields, such as industrial machinery. **Trans-Canada Air Lines** is to build a $5,000,000 jet-age maintenance base at Vancouver International Airport to accommodate the all-turbine air fleet the company expects to have by 1961. Work is now in progress on TCA's $20,000,000 overhaul and maintenance base at Montreal-Dorval Airport, the world's first facility of this kind designed specifically for turbine-powered aircraft.

●

The Canadian Air Transport Board has authorized Canadian Pacific Airlines to operate transcontinental services from Montreal to Vancouver. The Board's decision breaks the monopoly which Trans-Canada Air Lines has hitherto held on this route.

●

The Royal Netherlands Air Force has now awarded a contract to Fokker for twelve F.27 *Friendships* intented as *Dakota* replacements. Two of the aircraft will be equipped as airliners, the remaining ten will be troop transports. The contract is worth approximately 30 million guilders, the cost of the standard *Friendship* airliner without radio equipment being 2,300,000 guilders.

Workshop Briefs

The Convair 880 four-jet transport began flight tests on January 27th, 1959. After a flight of 1 hour 15 mins, Test Pilot Don Germeraad landed the 880 on the airfield at the Navy's North Island base where further tests are to be made. During the first flight a maximum speed of 200 knots was recorded ; the aircraft climbed to an altitude of 20,000 ft. Take-off distance was 3,500 ft. with an unspecified weight.

●

Rhein-Flugzeugbau is now equipping the RW 3 with a 90-h.p. Continental engine in place of the 60-h.p. Porsche originally fitted. It is anticipated that this will improve the aircraft's flight performance and make it more suitable as an off-duty trainer for Luftwaffe pilots ; the take-off and landing characteristics will then resemble more closely those of the Fouga *Magister.*

●

Davy Crockett is the designation of a new atomic rocket to provide infantry units with a small front-line nuclear weapon for use against targets only a few thousand yards away. The eight-inch rocket is designed with a lightweight launcher to be used in the same way that mortars are now used.

●

The first Vickers Vanguard commenced flight testing at Vickers-Armstrongs' Weybridge airfield on January 20th, 1959.

●

The Aviation Légère d'Artillerie (ALAT) has placed an order for 150 Nord 3400 multi-purpose aircraft, which will be powered by a 260-h.p. Potez 4D34 engine with supercharger.

●

The last of eight Hurel-Dubois HD.34s ordered by the Institut Géographique National (IGN) will be completed some time this month, and will then commence flight tests.

●

Lockheed Aircraft Corporation reports new double-duty capabilities for international models of the *Electra :* alternative utilization of the forward passenger compartment for carrying 3,500 lb. of extra cargo.

●

Northrop's N-156F counterair fighter has recently received some financial support from the U.S. Government, which may sponsor its continued development. The first N-156F is 60 percent completed, and manufacture of two others has begun.

●

The Northrop T-38 supersonic jet trainer has been officially designated *Talon* by the U.S. Air Force.

●

The 60th twin-engined Il-14P transport aircraft has recently been completed at the Dresden VEB Flugzeugwerke ; this aircraft is scheduled for delivery to the Polish airline LOT. In addition to deliveries to Poland, East German manufactured Il-14Ps are being delivered to Hungary, Bulgaria and now to the People's Republic of China. Production of the Il-14P will continue through 1959.

●

Audio-Sonics Corporation, at Canoga Park, Calif., has developed the *Harpy,* a one-man anti-aircraft missile for use against low-flying aircraft. Employing a bazooka-type launcher the missile is fired from the shoulder, and has an electro-optical homing device. The effective range is claimed to be in the order of 3 miles. In production, the missiles will cost less than $200 each.

●

Lockheed Missile Systems Division has been awarded a new USAF contract to continue flights of the recoverable X-7 ramjet test vehicle during 1959.

●

Sud-Aviation's La Courneuve plant continues to produce the *Alouette* helicopter, powered by the Turboméca *Artouste,* in quantity. Up to the beginning of this year, a total of 225 *Alouettes* had been delivered to customers at home and overseas ; the provisional plan covers a total of 500 aircraft. According to an *Interavia* report from Los Angeles, the U.S. Navy is apparently showing great interest in the *Alouette.*

●

The Soviet Union is promoting the accelerated development of modern 20 to 30 seat passenger aircraft with STOL characteristics, according to Moscow press reports.

●

Solar Aircraft Company reports that the 55-h.p. *Titan* gas turbine is undergoing initial tests as a power unit for one-man helicopters. A version of the *Titan* is being developed for ducted-fan flying platforms. Under a USAF contract, Solar is also studying the design of both short and long-life 100-h.p. airborne auxiliary power units, to be used at extreme altitudes and temperatures on manned and unmanned weapon systems.

●

A Douglas C-133A Cargomaster was loaded with 52,000 lb. of cargo in one hour 10 minutes during a loading demonstration at Travis AFB recently. The entire 52,000 lb. was unloaded in 50 minutes by a crew of five men and a fork-lift.

●

Bristol-Siddeley Engines is concentrating a great deal of development work on the ducted fan engine for future use in civil transports. It is understood that the *Orpheus* would form the basis of such an engine and, in its new form, powers staged from 9,000 to 12,000 lb. could be expected. It seems that Bristol Aircraft has based its new type 205 short-haul jet transport project on the Bristol-Siddeley ducted fan engine.

●

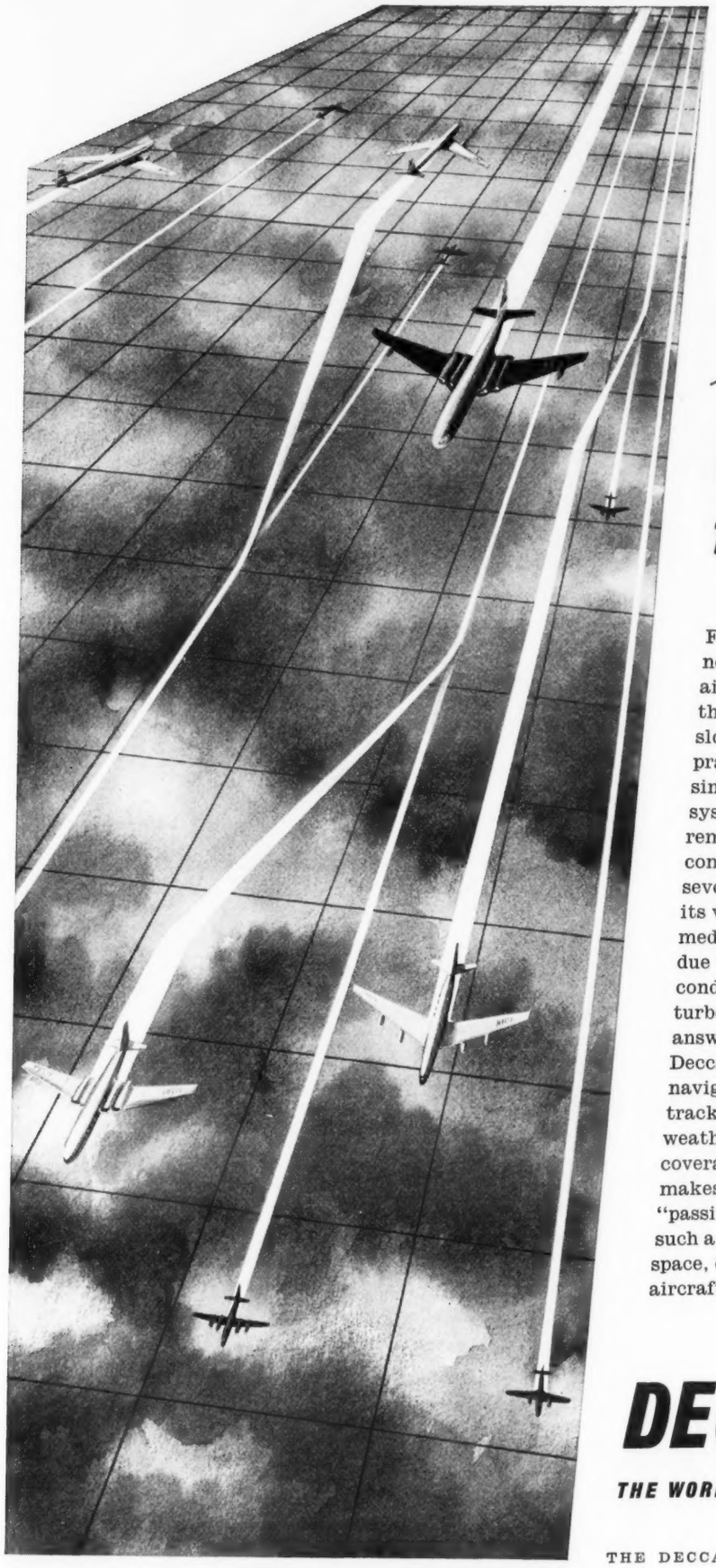
Siebel-ATG, of Donauwörth, has resumed development work on a sports aircraft based on the well-known pre-war *Hummel* design. Construction of the prototype has begun. The basic design of the earlier Siebel 204 is also to be developed into a twin-engine version.

●

A twin-engine development of the Do 27 (designated Do 29) has commenced flight tests.

●

North American Aviation, main contractor for the F-108 weapons system, announces that the Federal Division of the International Telephone & Telegraph Corporation, Clifton, N.J., has received a contract for the development and construction of a mission and traffic control system for the new USAF interceptor. The system is designed to provide communications, navigation, identification and landing aid functions. At the same time it was announced that a contract has been awarded to the AiResearch Manufacturing Division of the Garrett Corporation, of Los Angeles, for the development and manufacture of an airborne data computer for the F-108. The Central Air Data Computing System coordinates important data such as pressure, temperature, acceleration and angle of attack, processes the information, and feeds it to the pilot and other airplane systems to enable the F-108 to carry out its mission under optimum conditions. General K. B. Wolfe, executive vice president of the Garrett Corporation, said that more than half of the manufacturing will be subcontracted.



NAVIGATION for the JET AGE

From the dawn of aviation nothing fundamentally new has been added to the earliest principles of air traffic control. Until now these were founded on the requirements and limitations of relatively slow aircraft for which altitude separation was practical. Aircraft speeds and performance have since improved beyond recognition, but the basic system of navigation and air traffic control has remained virtually unchanged. Single tracks and common points of intersection are only two of the severe restrictions imposed on air traffic, threatening its very existence. The air, intrinsically a free medium, is swiftly becoming overcrowded and unsafe due to the extravagant waste of air space . . . a condition which the introduction of turbo-prop and turbo-jet aircraft will aggravate still further. Yet the answer exists today in a fully developed form: The Decca Navigator System enables all aircraft to navigate accurately and maintain any ATC-assigned track with precision, regardless of altitude, speed or weather conditions. This very accurate hyperbolic area coverage system, with its pictorial presentation, makes the introduction of lateral separation and "passing lanes", a reality. It is only by the adoption of such a system that full use can be made of the total air space, enabling the rapidly increasing numbers of aircraft to operate with safety and economy.

DECCA/DECTRA

THE WORLD'S MOST ACCURATE NAVIGATION SYSTEM

THE DECCA NAVIGATOR COMPANY LIMITED · LONDON

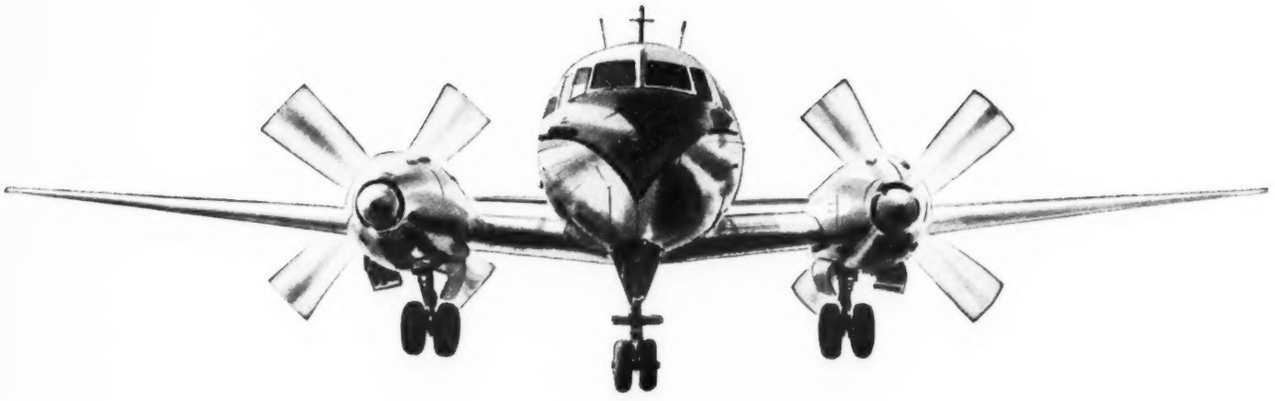
CANADAIR 540

SUCCESSOR TO THE CONVAIR 340/440

BIGGER PAYLOAD
FASTER BLOCK SPEED
GREATER ECONOMY
HIGHER PRODUCTIVITY WITH

ELAND TURBO-PROPS

TYPE APPROVED BY A.R.B. AND C.A.A.



The Eland engined
Canadair 540, latest version of
the world-famous Convair, offers a new
and formidable challenge on the short to medium-haul
routes. NAPIER Eland turbo-props will provide the Canadair 540 with
Performance, Passenger Appeal, Ease and Economy of Maintenance and a Revenue
Potential that will meet operators' requirements and growth for the next ten to fifteen years.

NAPIER Eland *turbo-prop*

D. NAPIER & SON LIMITED, LONDON W3, ENGLAND
A Member of The ENGLISH ELECTRIC Aviation Group

GRC E41

TI 'ELECTRONIC ESCORTS'

bring all-weather travelers safely home

SOON NOW, TI-BUILT and TI-modernized airport surveillance radars will meet air travelers far outside congested airport areas and escort them electronically to an ideal approach fix. The Civil Aeronautics Administration has already ordered this potent safety factor for more than *seven dozen* major U. S. airports. Able to keep tabs on large numbers of aircraft operating in airport approaches (up to 60 miles distant), TI radars will log all aerial moving objects over video maps pinpointing navigational aids and hazards. In "ducks only" weather, the traffic controller can switch from linear to circular polarization for a clear look through clouds and precipitation.

Close kin to Texas Instruments military and industrial electronics, TI airways radar benefits from the most advanced technologies practiced today. Details on this new aspect of TI's 29-year-old capabilities may be obtained by writing to: SERVICE ENGINEERING DEPARTMENT...

apparatus division

systems management

systems—airborne early warning, airways control, antisubmarine warfare, attack-bomb navigation systems, countermeasures, engine instrumentation, missile systems, portable ground equipment, reconnaissance, space electronics.

equipments— radar, infrared, sonar, magnetic detection, computers, timers, telemetering, intercom, microwave, optics, detector cells, engine instruments, transformers, time standards, and other precision devices.

research/design/development/manufacture

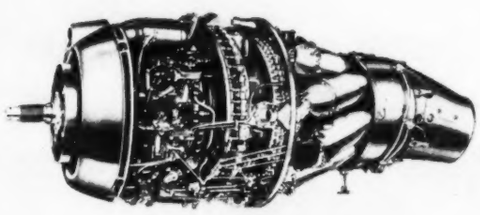
TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE
DALLAS 9, TEXAS

A NEW ERA

The Rolls-Royce Conway by-pass jet engine

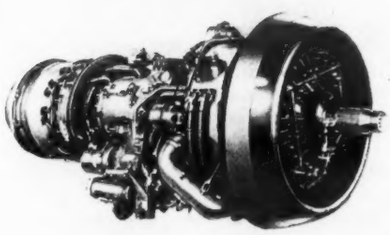
has now been granted a full certificate of airworthiness by the Air Registration Board at a minimum rating of 17,000 lb. thrust. Conways are now being delivered to aircraft manufacturers.

ROLLS-ROYCE EXPERIENCE IN THE AIRLINE OPERATION OF GAS TURBINES IS UNIQUE



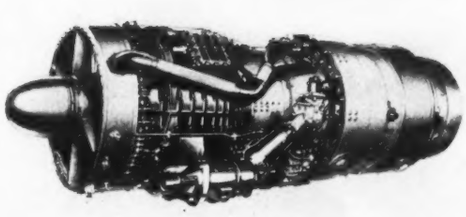
THE DART

—the first, and for four years the only prop-jet in airline service has flown over 6,000,000 hours. The Dart is currently operating at overhaul lives of up to 2,200 hours.



THE TYNE

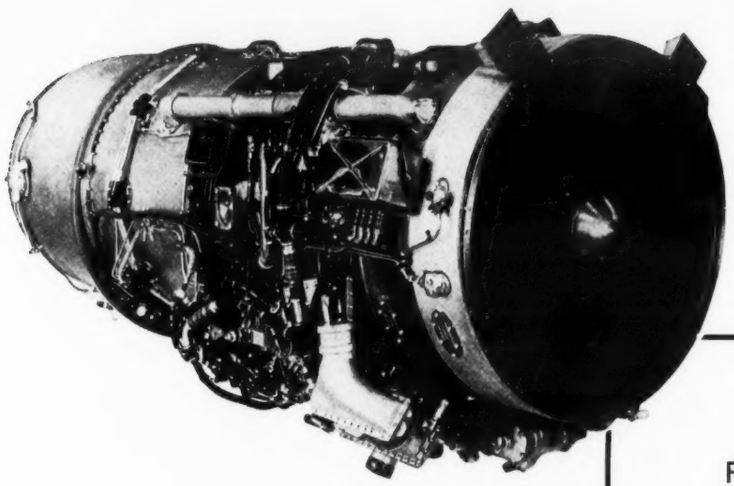
—a most advanced prop-jet engine, is due to enter service in 1960 at ratings of 4,985, 5,525 and 5,730 e.h.p. It has a specific fuel consumption comparable with the latest compound piston engines.



THE AVON

—the first turbo jet on the North Atlantic route, and now in daily service, began scheduled operations with an approved overhaul life of 1,000 hours.

IN JET POWER



DEVELOPED FROM EXPERIENCE

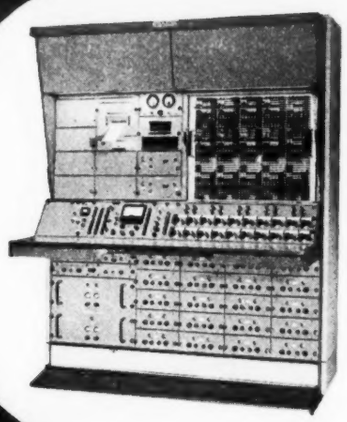
The by-pass principle which Rolls-Royce have proved in the Conway engine is now accepted as the correct formula for all jet transport and for certain military applications.

The new RB.141 family of by-pass jet engines is based on seven years' development experience of the by-pass principle gained with the Conway and on six years' operation of other gas turbine engines in airline service. The first of this series has already been chosen to power the new British European Airways medium range jet airliner.

ROLLS-ROYCE **GAS TURBINES**

ROLLS-ROYCE LIMITED, DERBY, ENGLAND

AERO ENGINES - MOTOR CARS - DIESEL AND PETROL ENGINES - ROCKET MOTORS - NUCLEAR PROPULSION

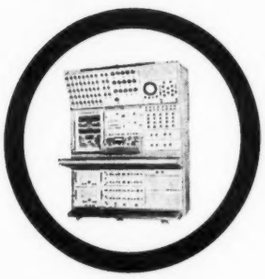


The new 231 R Computer can hold up to 100 amplifiers and other related non-linear equipment. New removable patch panel greatly speeds programming. Optional items include digital potentiometers and ADIOS (automatic digital input-output system)

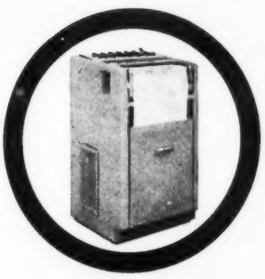
NEW "PACE" ANALOG COMPUTER 231 R...

... with highest precision : 0,01 o/o

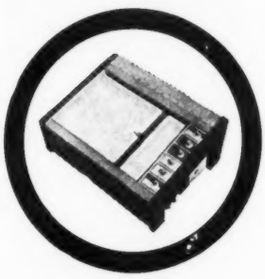
Dataplotter 1133 A.



131 R Analog Computer

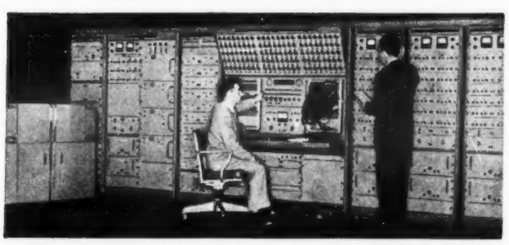


Eight Channel Rectilinear Recorder 1902-D.



Variplotter 1100-D.

Electronic Associates, Inc. has been the world's leading producer of Analog Computers and Plotting Equipment or over 5 years. For further information on their PACE Equipment the European Sales Office and Computation Center at Brussels is ready to assist European Industry



Rental facilities at European Computation Center in Brussels. Electronic Associates Application engineers are available to assist clients with their problems.

PRODUCERS OF "PACE" ANALOG COMPUTERS

ELECTRONIC ASSOCIATES, INC.

EUROPEAN SALES OFFICE AND COMPUTATION CENTER

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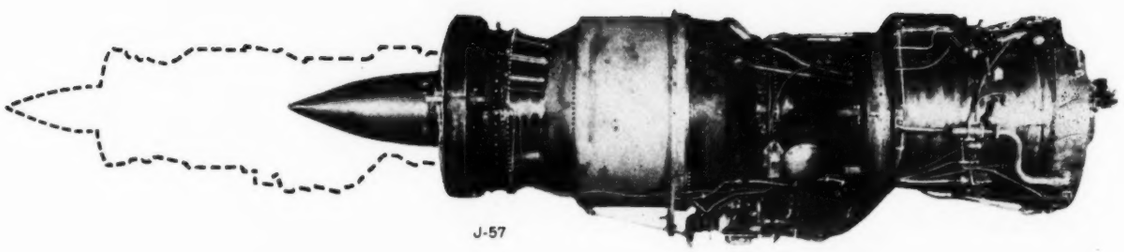
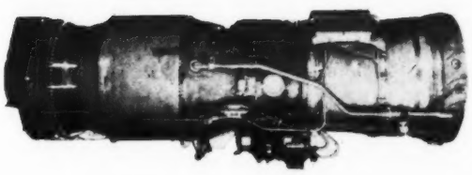
JT12

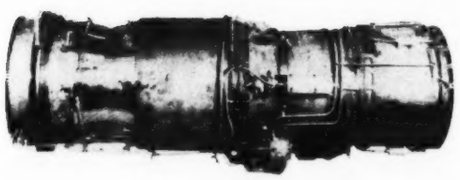
J-52



J-57



J-75



J-58

FATHER OF THE JET WORLD'S "FIRST FAMILY"

Powering more types of important modern jet aircraft than any other engine, the J-57 is the father of the world's "first family" of jet engines, all designed and produced by Pratt & Whitney Aircraft.

Success of the J-57 in military and civil aviation is unmatched. It powers nine major types of U.S. Air Force and Navy aircraft. In commercial form, as the JT3, it is the standard power plant in current models of Boeing 707 and Douglas DC-8 airliners. Millions of hours of service have proved the J-57 s efficiency, reliability, and stamina.

Design excellence of the J-57 has led to development of other outstanding Pratt & Whitney engines: the JT12, for executive transports, light fighters, reconnaissance aircraft, and drones . . . the J-52 for military aircraft and missiles . . . the J-75, now powering the most advanced U.S. fighter airplanes, and widely-ordered in its commercial version for long-range Boeing 707 s and Douglas DC-8 s . . . and the J-58, an extremely high-powered military turbojet.

In all power classes, these Pratt & Whitney engines are the "first family" of the jet world.

PRATT & WHITNEY'S J-57
POWERS THESE OUTSTANDING AIRCRAFT

NORTH AMERICAN F-100 • **McDONNELL** F-101 • **CONVAIR** F-102 • **BOEING** B-52 • **BOEING** KC-135 • **NORTHROP** Snark • **CHANCE VOUGHT** F8U • **DOUGLAS** F4D • **DOUGLAS** A3D • **BOEING** 707 • **DOUGLAS** DC-8

PRATT & WHITNEY AIRCRAFT

East Hartford, Connecticut, U.S.A.

Represented by : United Aircraft Export Corporation, East Hartford, Conn., U.S.A. European offices : 3/5 Warwick House Street, London SW 1, England.

An intensive and thorough evaluation carried out with Mk.1 aircraft has paved the way to the current production version, the Mk.3.
Refinements include hydraulically operated services, Martin Baker ejection seats, wing-tip auxiliary fuel tanks and a one piece moulded windscreen. All Jet Provosts are powered by the Armstrong Siddeley Viper turbo-jet.

"The Aeroplane" photo

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LUTON, BEDFORDSHIRE, ENGLAND and at 1450, O'CONNOR DRIVE, TORONTO, CANADA

Sidelights from Washington

U.S. Defence Policy for Fiscal 1960

The budget proposals for Fiscal 1960 (July 1st, 1959 to June 30th, 1960) which President Eisenhower submitted to the Congress on January 19th, 1959 cover a total expenditure of roughly $77,000,000,000, including no less than $40,900,000,000 for defence. This means that a gigantic proportion of 53 percent of the total budget estimates will be earmarked for national security. Some indications of the purposes for which these funds will be used are to be found in the President's Budget Message on January 19th and in the State of the Union Message which Eisenhower read to the 86th Congress on January 9th, 1959.

The United States must have powerful, flexible forces *for all kinds of conflicts*, the President declared. Will this be achieved ? To judge by the U.S. defence programme, it seems as if first priority is still being given to super weapons for global war — or, to put it more accurately, for its prevention : *" Our formidable air striking forces are a powerful deterrent to general war ... Great strides have been made in the development of ballistic missiles ... The Atlas intercontinental ballistic missile programme has been marked by rapid development, as evidenced by recent successful tests."*

Nevertheless, the United States is still feeling its way cautiously forward into the new weapons fields, as is revealed by the development and production of manned supersonic combat aircraft, which today cost fifty or even a hundred times as much as the corresponding first-line aircraft of World War II : $17,600,000 for a single North American A3J *Vigilante* naval attack aircraft and no less than $26,700,000 for the Convair B-58 *Hustler*. This makes $650 per pound of structural weight for the A3J and $567 per pound for the B-58. These aircraft cost more than their weight in gold ! It is therefore scarcely surprising that orders for types of this value are not forthcoming in the hoped-for numbers.

In addition to these two aircraft, it is above all the North American B-70 supersonic bomber and the North American F-108 long-range interceptor which receive highest priority, though additional funds are also requested for the Boeing B-52G long-range bomber, which is to serve as carrier aircraft for new-type air-to-surface missiles. Reportedly one hundred more B-52Gs are to be built, and SAC's bomber units are to be equipped with the North American GAM-77 *Hound Dog* air-to-surface missile in the coming fiscal year.

Although it is planned to reduce the number of Air Force wings — including missile wings — from 105 to 102 by June 30th, 1960, the future of the manned bomber seems to be assured, in view of the introduction of the *Hound Dog* and the successful testing of ballistic air-to-surface weapons (Project *Bold Orion)*. The medium-range rockets known as weapons system WS-199 and discussed elsewhere in this issue would be carried to a favourable launching point by jet bombers and then fired over distances of 1,000 to 2,000 miles, thus enabling the bombers in most cases to stay outside the range of enemy defences. More important still, these reprisal missiles could be rescued from threatened enemy rocket attacks, since their carrier aircraft could take off immediately on receipt of warning of an impending attack. As these lines go to press the USAF has announced plans to invite a number of manufacturers to take part in a development contest for the WS-199 ; a decision may be expected this year.

★

The growing importance of missiles emerges even more clearly from the new budget proposals, which request a total of roughly $7,000,000,000 for the Air Force, Army and Navy missile programmes ... excluding the additional billions to be spent on research and development ! The fantastic figures which the budget planners in the Pentagon have to handle are revealed by President Eisenhower's comment that each *Atlas* ICBM introduced into the firing line will cost around $35,000,000 (including the necessary ground equipment). And the arsenal of long-range missiles required by the United States runs into hundreds.

The first *Atlas* missiles will be at the launching sites by the end of June this year. The fifty percent increase in funds requested for the *Titan* ICBM suggests that this second long-range rocket programme will now be continued. At any rate the U.S. Department of Defense has agreed that another seven USAF squadrons may be equipped with the *Titan*, so that by mid-1960 the Air Force will have twenty ICBM squadrons with a total of around 200 long-range missiles : eleven equipped with *Titan* and nine with *Atlas*. The *Polaris* submarine IRBM, due to come into operation in 1960-61, and the *Minuteman* ICBM (also solid-propellant) for 1963 continue to head the priority list. Even the *Thor* and *Jupiter* IRBMs, which are coming into squadron service during the current fiscal year, will continue in production — contrary to earlier reports — until 1960, for both the U.S. forces and a number of European NATO countries. Additional funds are also requested in order to speed up the *Bomarc, Nike Hercules* and *Hawk* air defence missile programmes. As regards Army missiles, the *Redstone* tactical short-range rocket is to be cancelled in favour of an expansion in the development programme for the *Pershing* solid-propellant rocket.

The hopes of the U.S. Navy have not been fully met. Only recently it was obliged to give up its *Regulus II* jet-powered missile, although $78,000,000 had already been spent on the Chance Vought weapon, and several surface vessels and submarines are being converted to take the *Regulus IIs* which have so far been produced. Instead the Navy will get increased support for its atomic submarine programme and will be able to continue construction of its first nuclear-powered aircraft carrier. Six atomic submarines to carry *Polaris* missiles are on the stocks, and one of them is scheduled to go into service during Fiscal 1960. In addition the Navy has been able to announce plans for the construction by General Dynamics Corporation of new missile-launching submarines, which will be heavier and longer than the 5,600-ton vessels now under construction. The first of the new submarines will cost $105,000,000 ; the *Polaris*-carrying submarines now being built will cost $50,000,000 apiece. The total funds earmarked for basic research and development of new weapons systems in the budget estimates run to $3,384,000,000, not including the development funds for the *Nike Zeus* anti-ICBM missile and the *Dyna-Soar* global glide bomber.

★

So much for the United States' most important super weapons. That work is also going ahead on tactical weapons is revealed, for example, by the fact that the solid-propellant *Sergeant* short-range missile is now in production. Finally, the statement that the number of U.S. Army missile battalions is to be increased to eighty by the end of the next fiscal year is a sign that the Pentagon is fully aware of the growing importance of tactical multi-purpose weapons in both local and global conflicts.

In view of the continuance of the cold war the somewhat miserly treatment of the Army seems slightly hazardous. Altogether the United States must limit the strength of its armed forces to two and a half million men, of which the Army is to have only 870,000, while the Soviet Union and its European satellites are estimated by NATO to have more than 6,000,000 men under arms. However, President Eisenhower appears to have been prepared for such objections to American defence planning, which he answered in his budget message with the following words : " ... By concentrating our efforts on the more advanced and more promising weapons systems we can increase substantially the combat capabilities of our military forces with a relatively small increase in the overall cost of defence."

The Fiscal 1960 Procurement Plans of the Three Armed Services

Air Force:

Funds requested total $18,682,000,000.

Strength: Strategic Air Command—43 wings; Tactical Air Command—34 wings; Air Defense Command—25 wings; Military Air Transport Service—24 squadrons; air fuelling squadrons—63; also 59 specialized squadrons of various types. The Budget calls for a total of 19,982 aircraft for the USAF, of which 703 will be acquired in the coming fiscal year. 845,000 personnel.

U.S. Navy:

Funds requested total $11,370,000,000.

Strength: A total of 864 ships and 9,200 aircraft divided into 16 carrier air groups, 22 carrier anti-submarine squadrons, and 42 patrol and warning squadrons. The Navy will also have three Marine divisions and three Marine air wings.

By June 30th, 1960, five *Forrestal* class attack carriers will have replaced five *Essex* class carriers, and three more will be under construction, including the first nuclear-powered carrier. Five guided missile destroyers and frigates will be in commission, including the first nuclear-powered frigate, as well as the first nuclear-powered IRBM submarines. Similarly, several cruisers, destroyers and auxiliary vessels will be converted to guided missile armament. The Navy's personnel will total 630,000; the Marine Corps will have 175,000.

U.S. Army:

Funds requested total $9,357,000,000.

Strength: 14 Army divisions; four missile commands; eight battle groups; three heavy field artillery missile groups. The cut of one division will be compensated to a certain extent by two extra battle groups and one extra heavy missile group. Aircraft will total 5,363, including 2,558 helicopters and 2,805 fixed-wing aircraft; in the coming fiscal year the Army will acquire 239 new aircraft, including a large number of turboprop observation aircraft. Personnel—870,000.

INTERNATIONAL MEETINGS AND CONFERENCES

Feb. 4th-5th : Air Cadet League of Canada, Annual Meeting. Quebec City.

Feb. 4th-5th : National Association of State Aviation Officials, National Board of Directors Meeting. Washington, D.C.

Feb. 5th-6th : Industrial Management Engineering Conference at Illinois Institute of Technology, Metallurgical and Chemical Engineering Building. Chicago, Ill.

Feb. 9th : IATA Clearing House and Revenue Accounting Sub-Committee. Miami, Fla.

Feb. 10th : ICAO, special communications, operational practices and accident investigation, rules of the air and air traffic control and search and rescue meeting. Montreal.

Feb. 12th-13th : 1959 Solid State Circuits Conference, sponsored by the Institute of Radio Engineers' Professional Group on Circuit Theory, American Institute of Electrical Engineers' Committee on Electronics and the University of Pennsylvania. Philadelphia, Pa.

Feb. 12th-13th: Computer and Data Processing in Industry, conference for manufacturing and engineering management. Purdue University, Lafayette, Ind.

Feb. 13th : IME Ordinary Meeting in conjunction with the Applied Mechanics Group, "Industrial Ramming of Small High Speed Air Compressors", by Prof. F. K. Bannister. London.

Feb. 14th : Meeting on Short-Range Navigational Aids—International Civil Aviation Organization. Montreal.

Feb. 16th (postponed from Jan. 20th) : IATA Reconvened Meeting of the Fall Composite Traffic Conference. Paris.

Feb. 16th : IATA Traffic Handling and Accountancy Working Group. Miami, Fla.

Feb. 16th-17th : Annual Meeting of the Royal Canadian Flying Clubs Association. Montreal.

Feb. 20th : Hydraulics Group of IME - discussion "Choice of gas temperatures and steam and pressure conditions in nuclear power stations". London.

Feb. 21st-22nd : 13th Annual Pacific Coast Mid-Winter Soaring Championships. Torrey Pines Gliderport, San Diego, Calif.

Feb. 23rd-24th : Canadian Aeronautical Institute Special Meeting, 50th Anniversary of Powered Flight in Canada. Montreal.

Feb. 25th : IATA Data Processing Sub-Committee. Paris.

Feb. 26th-27th : ATA Ticketing and Baggage Committee. Miami Beach, Florida.

Feb. 26th-March 1st : 1959 Engineering Exposition. Balboa Park, San Diego, Calif.

March 2nd : IATA Reservations Working Group. Miami, Florida.

March 2nd-5th : AGARD - "Interference Effects in Aerodynamic Test Facilities" - Wind Tunnel and Model Testing Panel. Brussels.

March 3rd : IATA Traffic Conference 3 Agency Sub-Committee. Paris.

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New York Finance Notes

The Investment Bankers Association Report

BY SCOTT HERSHEY, NEW YORK

The Aviation Securities Committee of the Investment Bankers Association, composed of some of the most knowledgeable money men concerned with a volatile industry, has come up with a report which does not make too happy reading for the start of the New Year.

The committee has taken a long, hard look at the financial problems of both the airlines and the aircraft manufacturers and while they have found much to cause concern, being practical people, they also have offered some recommendations to help meet the situation. The committee said that the financial problems of the airlines are, in part, the result of unfavorable regulation by the Civil Aeronautics Board and, in part, the inherent consequence of a highly competitive industry engaged in massive reinvestment during a lull in the growth cycle. The intensity of industry competition has forced each major carrier to finance jet re-equipment programs regardless of its internal economics, or face competitive oblivion.

The IBA committee said that some of the airlines are in technical default on liquidity provisions for present borrowings and that the industry's long-term debt equity ratio makes difficult additional long-term borrowing.

The airlines face within the next few years a non-recurring but major problem in the form of mass obsolescence of their entire piston fleets and the danger of a used airplane market glut resulting in depressed re-sale prices, the committee said. This situation has been commented upon previously in *Interavia's* columns.

As one approach to the problem, the IBA committee recommended that the Federal Aviation Administrator negotiate with U.S. foreign lending agencies and the World Bank to provide special credit or loan guarantees, allowing foreign countries to finance the acquisition of used airline equipment for foreign use.

Eastern Air Lines, just recently, has become one of the first of the large U.S. carriers to resort to equity financing to help pay the heavy cost of acquiring a fleet of turboprop and jet airplanes. Arrangements have been completed by Eastern to sell a five percent convertible note for $25,000,000 due in 1978 to the Prudential Insurance Company. The new obligation, dated December 16th, 1958, will be convertible into common stock at any time up to December lst, 1968 at $41 a share. The common stock of Eastern has been around 35 on the New York Stock Exchange.

Eastern also has obtained $50,000,000 revolving credit, good until 1960, from a group of eighteen banks headed by Chase Manhattan. This credit arrangement provides for interest at one quarter of one percent above the prime commercial rate at the time of the borrowing, with a minimum of 3½ percent and a maximum of 4½ percent.

Any funds drawn against the credit and outstanding on December 31st can be refunded into a loan repayable in 12 equal installments starting in March 1962. The borrowing under this refunding arrangement would be at interest rates of one quarter of one percent above the prime commercial rate, with a minimum 3¾ percent and a maximum of 4¾ percent.

With this arrangement and financial assistance, Eastern, back flying again early in January after a crippling strike, would be assured of necessary funds for the purchase of $235,000,000 of turboprop and jet aircraft it has on order from Lockheed and Douglas.

Northwest also moved to finance long-range projections of needs for outside money and to acquire 10 Lockheed turboprop *Electras* and five Douglas turbojets. The financing, arranged by First Boston Corporation, is in three parts :

1. $32,500,000 in credits from a group of 14 banks joined by the Bankers Trust Company, New York. The credit agreement provides for funds available on a revolving basis at 4¼ percent to June 30th, 1960, at which time any remaining money becomes a five-year term loan at 4⅝ percent.

2. $40,000,000 in 6 percent long-term promissory notes due October lst, 1978, and placed with a group of 12 insurance companies headed by Prudential Life and Northwest Mutual. Sinking fund provision of $3 million annually starts in 1966.

3. $11,446,825 representing subscription to 457,873 shares of 5¼ percent preferred stock $25 par, convertible in perpetuity into common at $26.

The IBA committee stated that CAB rate and depreciation policies place in jeopardy about $2.6 billion which the airlines project they might reasonably raise from internal sources. Of the $1.4 billion external capital requirements, some $510 million now remains unfinanced.

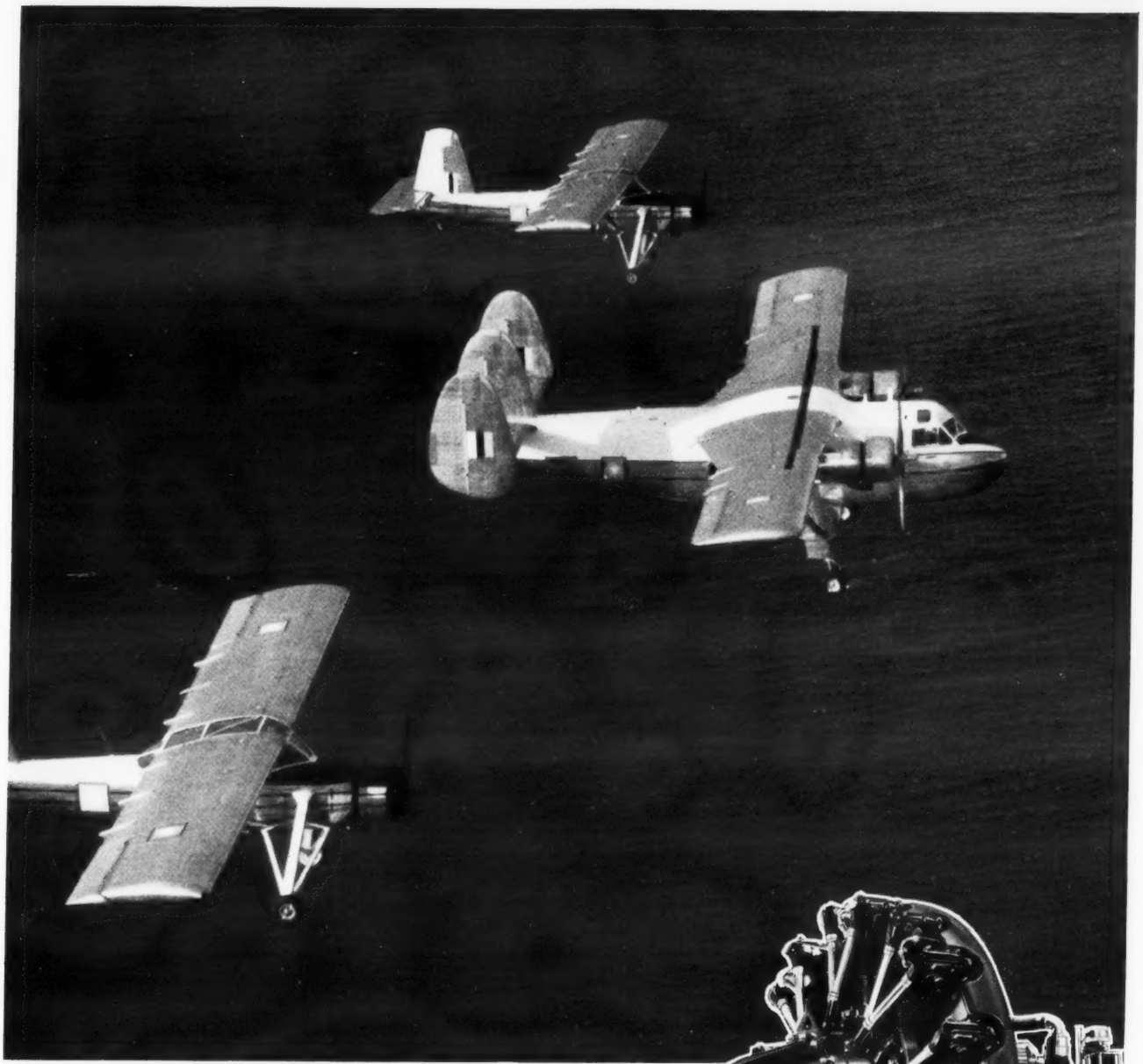
Turning to the aircraft manufacturing industry, the IBA committee, noting that as more than 85 percent of sales are to the Government, the industry is necessarily dependent upon Defense Department policy and that this policy has forced one of the most rapid changes in basic product mix and production techniques in industry history.

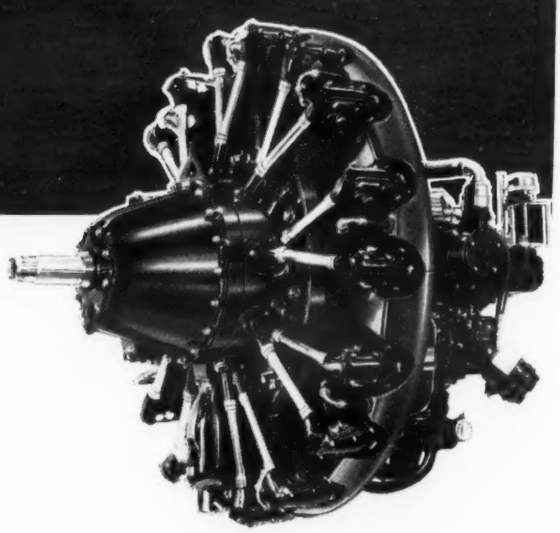
Most fundamental, of course, has been an accelerating shift from the industry's former product, aircraft, to a basically new product, missiles. This situation, too, has been commented on previously in *Interavia* columns.

The committee noted that the complexity and altered nature of the new weapons systems has required the individual company to subordinate itself to a systems team. The aircraft manufacturers have been required to make large additional investments in new missiles, electronic and testing facilities at the same time they are faced with mass obsolescence of their old airframe facilities.

The financial consequences of this major alteration in the face of the industry, combined with the transition to commercial jet aircraft production, may not be favorable in the immediate future. It is likely, the committee said, that the total aircraft industry sales and margins will decline in 1958 and possibly in 1959.

In view of the magnitude of the changes involved, the committee again urged Secretary of Defense McElroy to set up a permanent industry committee to negotiate a series of mutually acceptable proposals for presentation to Congress, where necessary, to allow the industry the financial and managerial leeway to adjust to this major transition period.





Power for the Pioneer

The Scottish Aviation Twin Pioneers and the Single Pioneers, now going into service with the Royal Malayan Air Force, are powered by Alvis Leonides Aero Engines.

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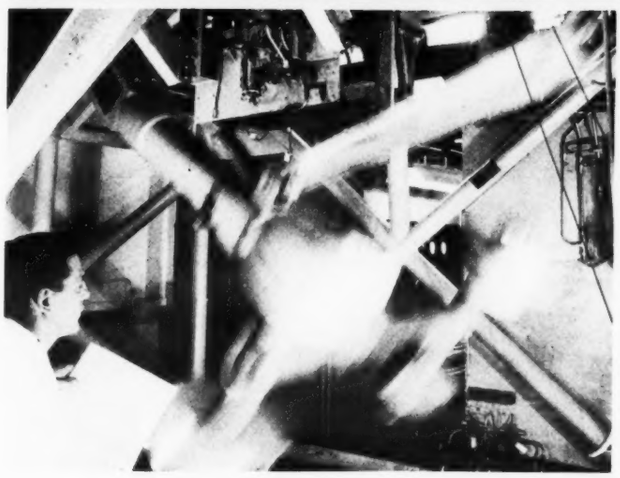
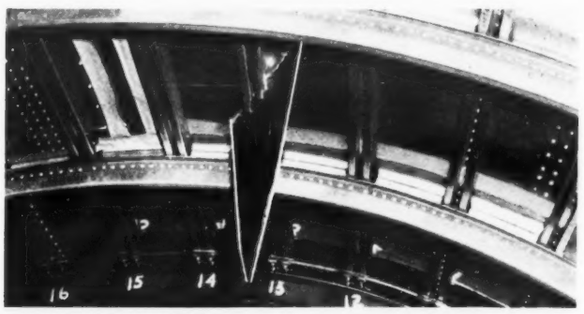


8000 CYCLES. Structural integrity beyond that of any other transport aircraft was designed and built into the Boeing 707 – and proved out in more than four years of prototype test-flying and ground testing of components. Landing gear, above, was put through 8000 test operating cycles.

TORTURE RACK. A KC-135 jet transport-tanker recently completed a 15-month static test, culminating in a test-to-destruction to determine its absolute limits of endurance. During the test, loads were applied to force wing-tips through a 16-foot arc. Flaps, spoilers, engine mounts, rudder and other components all *proved* capability of taking far greater stresses than would conceivably be encountered in flight operations.

TANK TEST. Though Boeing has built more pressurized aircraft than any other company, jet aircraft fuselage is put through underwater cabin pressurization tests to simulate 50000 high-altitude "flights". During each cycle, loads simulate normal flight loads, such as those imposed by take-offs, cabin pressurization, wind gusts and landings, plus passenger and cargo weight.



"TEAR-STOPPERS", shown in the picture above, confine any possible damage to limited areas – even damage inflicted in tests by a heavy steel blade. Throughout, the 707 and the shorter-range 720 benefit from the wide experience Boeing has gained in building more than 1600 large, multi-jet aircraft – more than any other manufacturer in the world.

Thees airlines already have ordered Boeing jetliners: AIR FRANCE · AIR INDIA · AMERICAN
B.O.A.C. · BRANIFF · CONTINENTAL · CUBANA · LUFTHANSA · PAN AMERICAN
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meets today's requirements, leading foreign experts agree

Designed and tested for operation from short **auxiliary landing fields** or even **grass runways** and to use **heavy ground attack weapons,** even in broken country and bad weather ; thanks to its unique special-type slats, the aircraft has unusually good qualities in low-speed flight.

MAIN FEATURES :

- Very good stability in all attitudes and throughout the speed and altitude range.
- No wing over under all flight conditions.
- Great manoeuvrability and good controllability, even in the stall.
- An excellent gun platform ; mean hit probability attained over 60 %, maximum over 80 % !
- Spin-proof in all operating conditions. The aircraft immediately comes out of even an inverted spin merely by releasing the controls.
- Safety factor of 13—or roughly 1/3 higher than is normal for fighters—ensures adequate life and strength even when the aircraft is used exclusively for very low-level operations and in mountainous country.
- Full speed and acceleration retained regardless of load conditions.

PERFORMANCE :

with Armstrong-Siddeley Sapphire ASSa. 7 engine

- Maximum speed . . . . . 685 m. p. h.
- Stalling speed . . . . . 112 m. p. h.
- Take-off distance . . . . . 1,575 ft.
  with rocket assistance . . . 0 - 165 ft.
- Landing distance . . . . . 1,440 ft.
  with brake parachute . . . 985 ft.
- Climb to 32,800 ft. in . . . 4 mins.
- Service ceiling . . . . . 46,000 ft.
- Minimum radius of turn . . 1,150 ft.
- Range near ground . . . . 470 miles
  with auxiliary tanks . . . . 620 miles

EQUIPMENT AND ARMAMENT :

- Modern radio and navigation equipment.
- Radar gun sight.
- Automatic ejection seat.
- Armoured pressure cabin.
- Two H. S. 825 30-mm high-performance cannons muzzle velocity 36,000 ft./sec, rate of fire 1,000 r. p. m.
- Four bomb racks for :
  — H. E. bombs up to 1,100 lb.
  — 100-gal. napalm bombs.
  — 100-gal. auxiliary tanks.
  — Rocket containers for 19 × 8-cm rockets each.
  — Camera container.
  — Homing rockets.
- Racks for 48 - 60 precision rockets type H.S.R. 80 (8-cm) beneath the wings.
- High - speed automatic launcher for 44 × 6.75-cm air-to-air missiles in the fuselage.

Total military load up to 5,720 lb.

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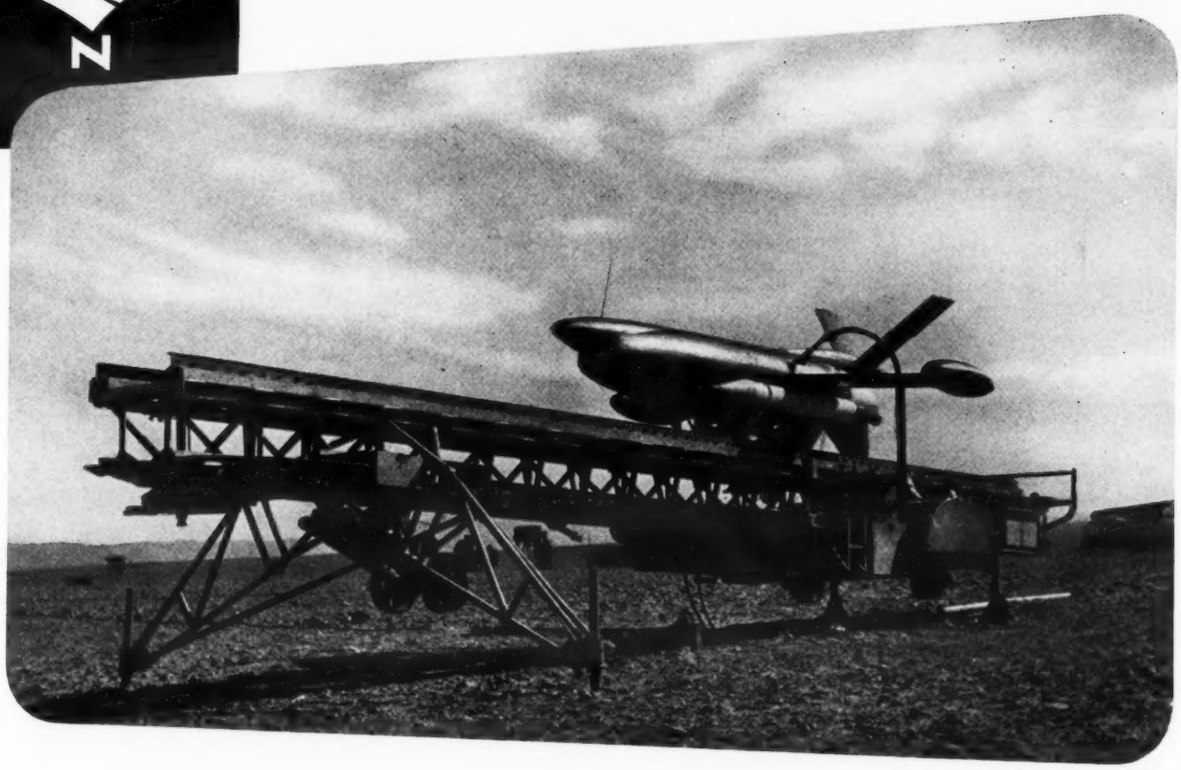

CT. 20

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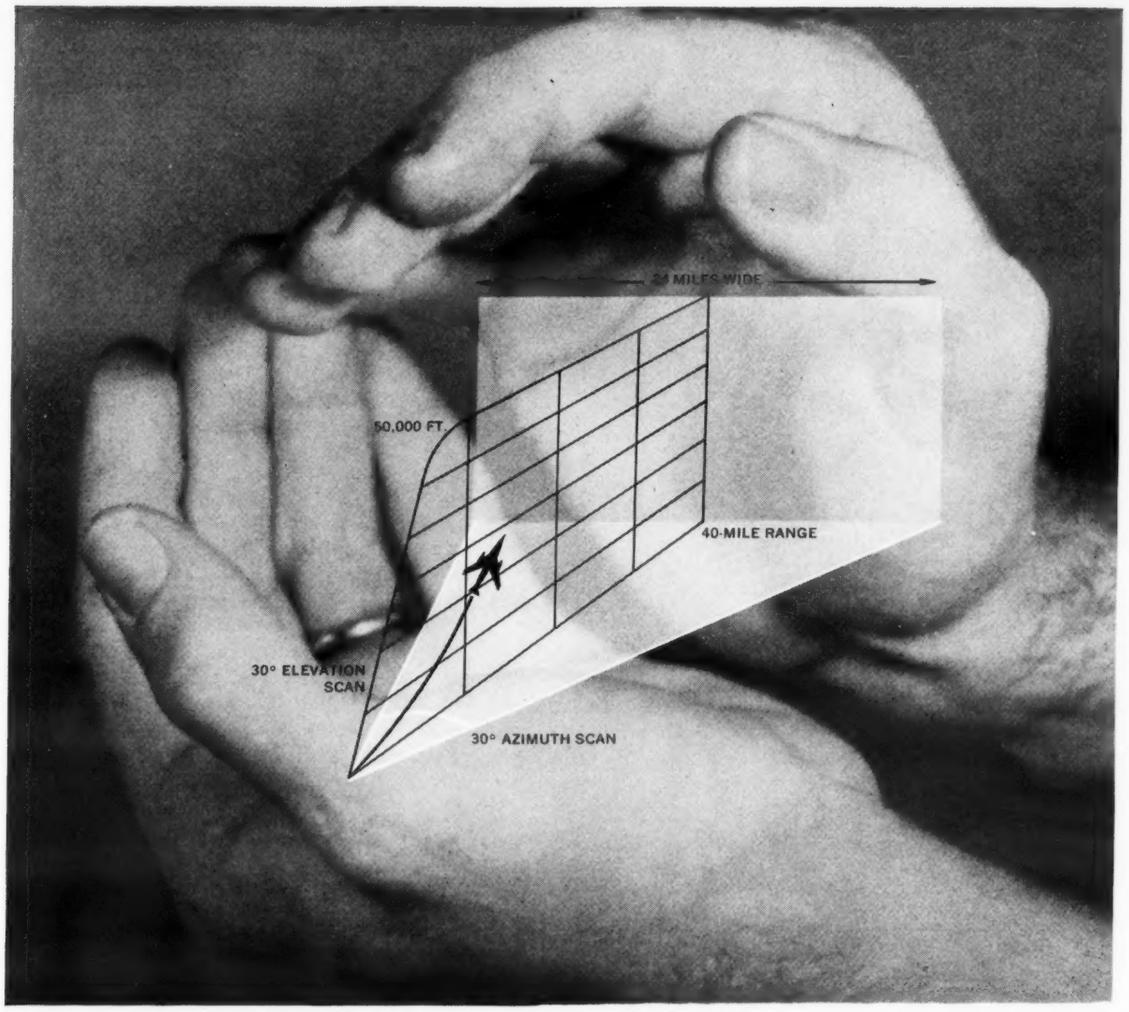

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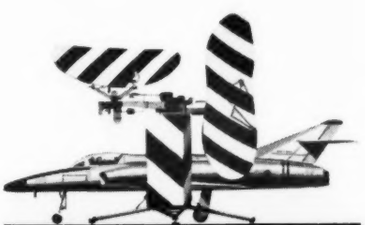
Quadradar's unique versatility is providing air traffic controllers with accurate, safe altitude separation, monitored TACAN approaches, thunderstorm avoidance, and multiple runway coverage. It is also used as a toss-bomb trainer.

Gilfillan's manufacturing experience since 1912 and creative capabilities in the fields of Air Navigation, Radar Trainers and Ground Support Equipment, Electronic Countermeasures, Missile Systems and Instrumentation, are available for complete research, development and production in these and related fields.



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This maintenance record is as outstanding as the safety record logged by Tigers on squadron duty.

The same safety and maintenance-free features are inherent in the higher performance F11F-1 Super Tigers. Backed by Grumman's world wide field maintenance service, Super Tigers would literally be two-for-one fighters in readiness to scramble.

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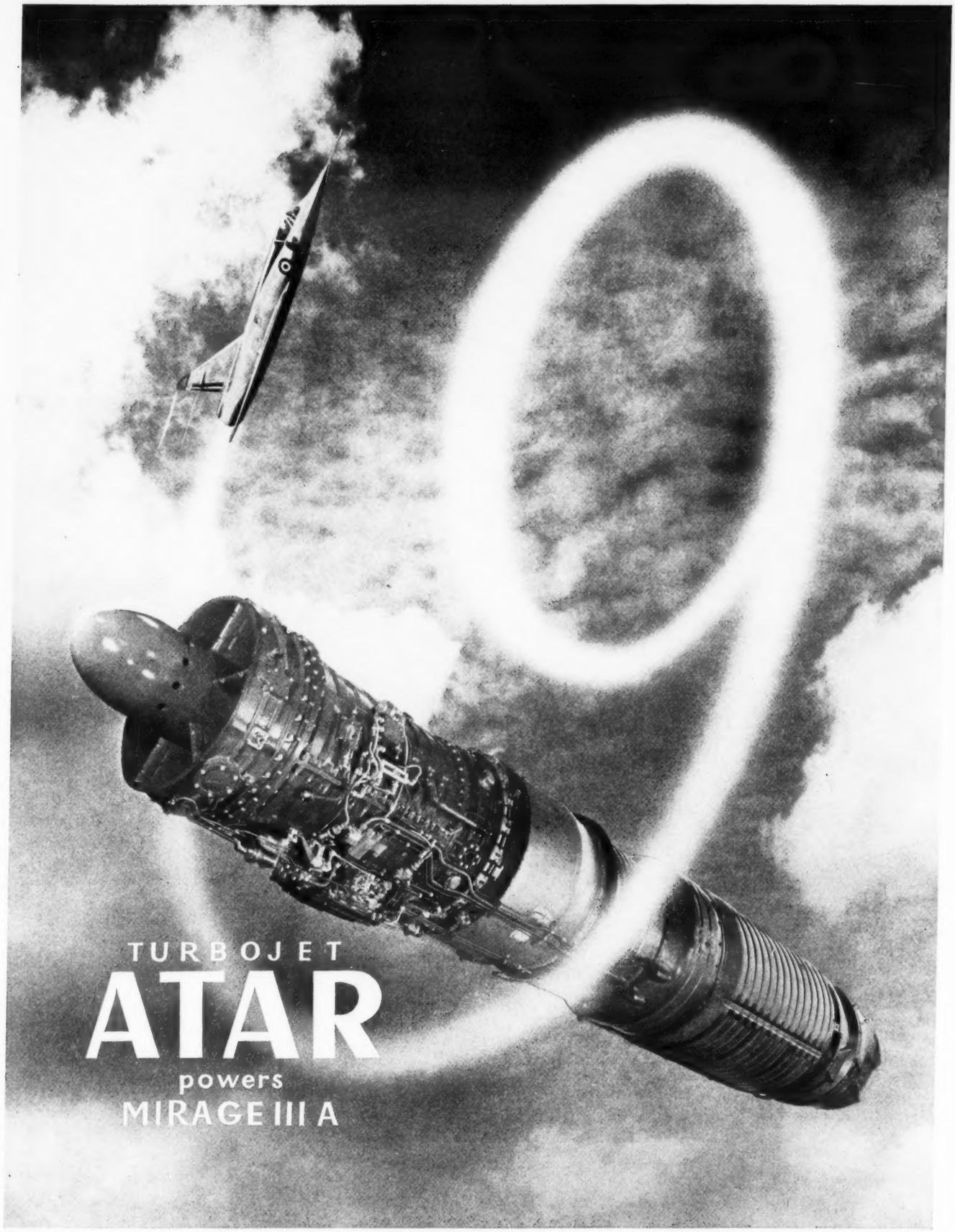

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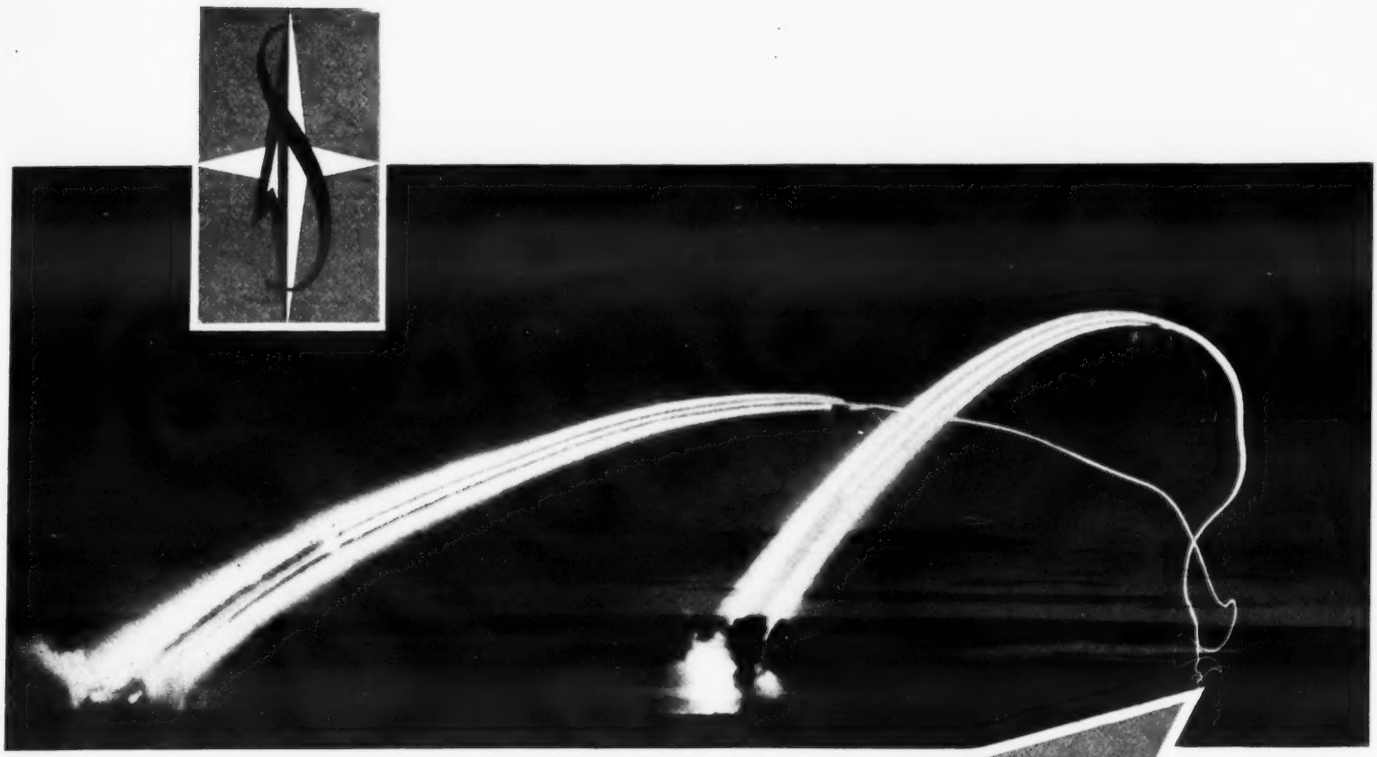

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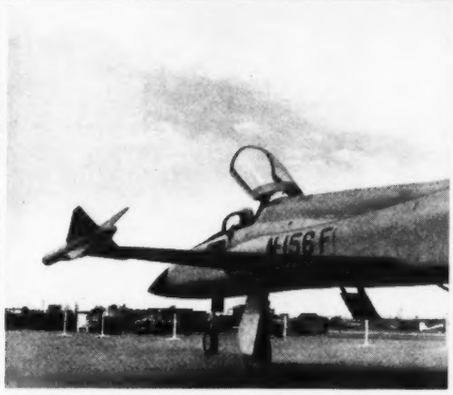

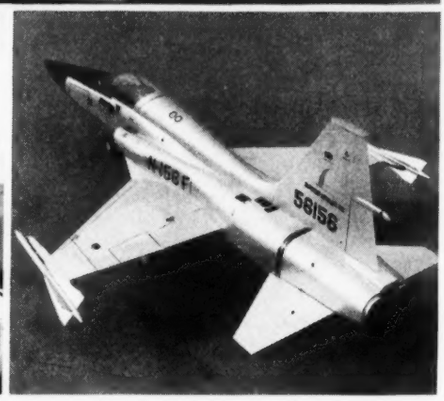

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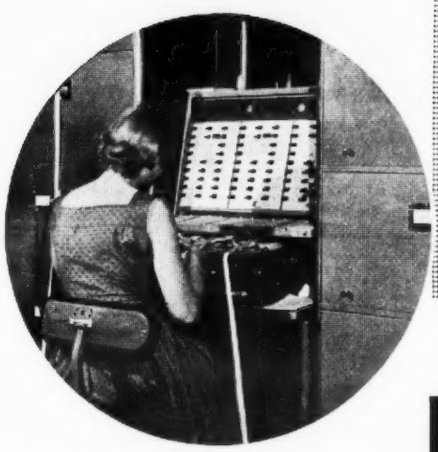
NORTHROP INTERNATIONAL
A Division of Northrop Aircraft, Inc., Beverly Hills, California, U. S. A.



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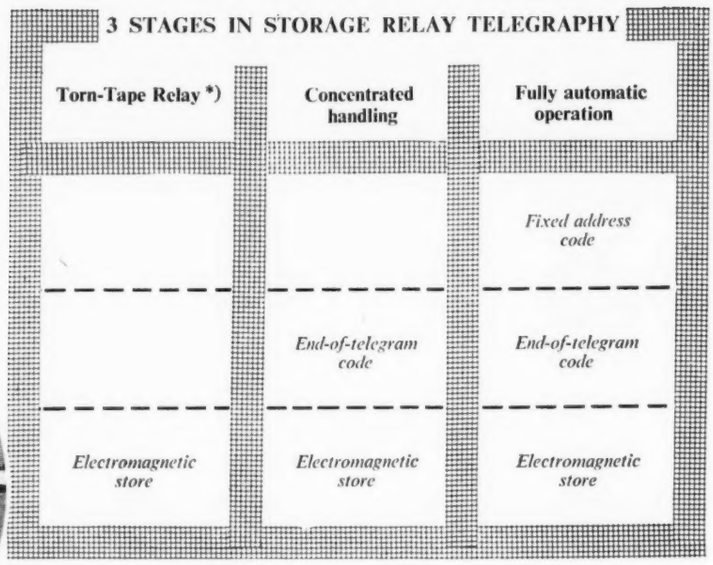

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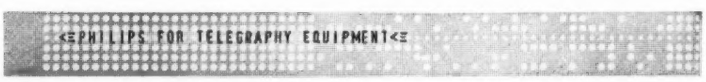

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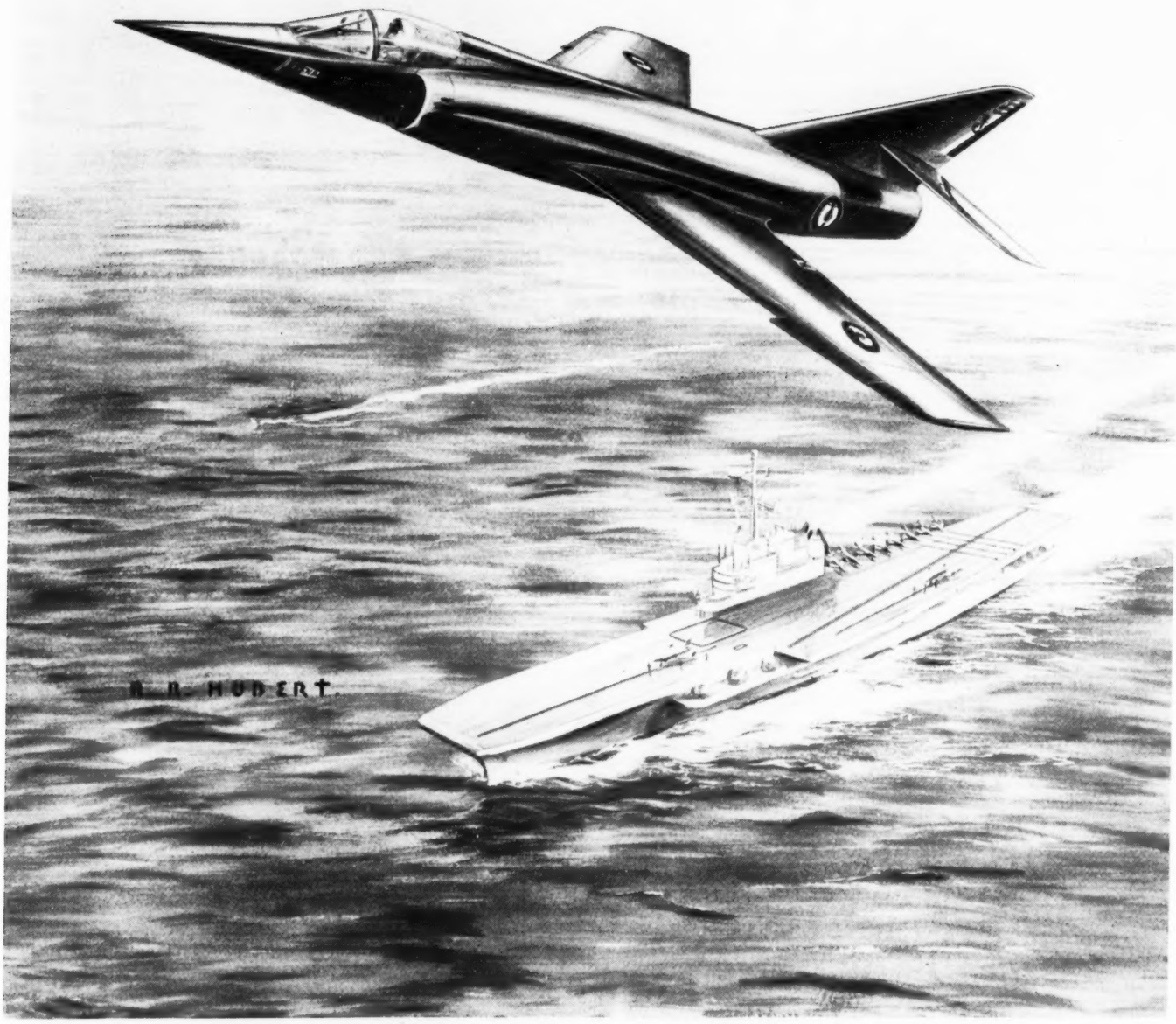

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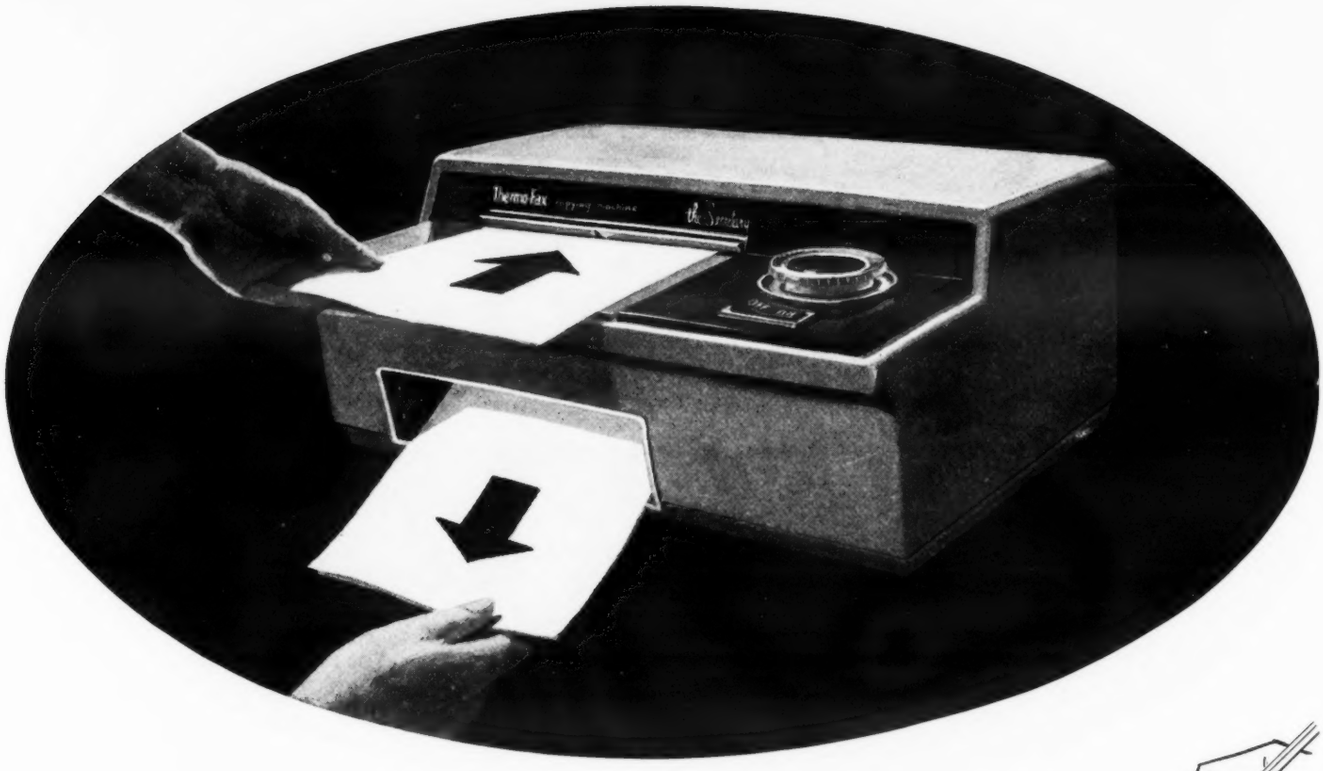

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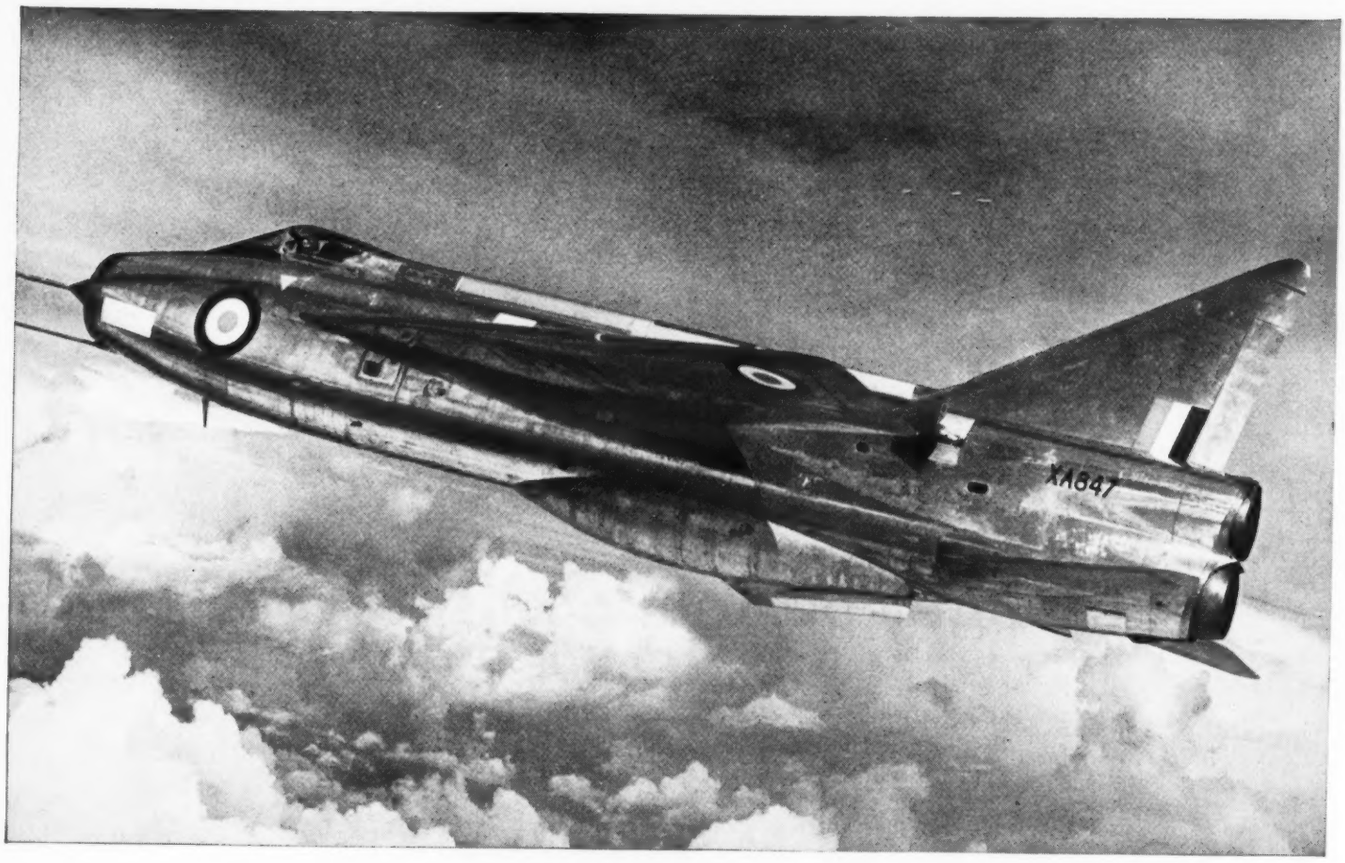

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Interavia Essay Competition

Announcement No. 1

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1. **Air Travel for All**
2. **Guided Missiles or Piloted Aircraft?**

The Competition rules and the composition of the panels of adjudicators, etc. were published on page 495 in No.6, 1958 and repeated on page 659 of No.7, 1958. Other notices were published at various times up to December 1958.

The last date for receipt of manuscripts by the Publishers in Geneva was December 31st, 1958.

By this date 235 manuscripts had been received from 28 different countries, in English, French, German and Spanish.

A breakdown by countries will be given in Announcement No. 2, in the March issue.

A first scrutiny of these manuscripts will be made by a special committee composed of members of Interavia's *Editorial Staff, which will, however, have no power of decision.*

It is then planned to supplement this committee with a number of examiners from outside Interavia *to ensure complete objectivity in the preliminary assessment.*

These measures will in no way prejudice the work of the two adjudicating panels, who alone have final authority to judge all essays. Furthermore it is once again recalled that the names of the participants will remain in sealed envelopes until the panels have made their decisions.

It is planned to invite members of the panels to gather in Paris at some date between June 11th and 21st, 1959. Paris has been proposed, as many members will be visiting the Air Show at that time.

Other announcements will follow, including the exact date set for the distribution of the prizes.

INTERAVIA S.A., Geneva

The hopes and enthusiasm of the many operators, mostly former air force officers, who believed in the Golden Age of air cargo in the years immediately following World War II were understandable. The United States Army Air Forces were offering thousands of transport aircraft for quick sale at rock bottom prices. Thousands of pilots were looking for a peacetime job and argued that the return of peace must go hand in hand with a vast reconstruction programme and a reactivation of trade and commerce.

However, by the time the Korean war broke out the picture had changed considerably. There was no shortage of cargo capacity, but the volume of air freight available did not come up to expectations, partly because the world was going through a slight economic crisis, but above all because there were far too many of these enterprising young men in the business, and many of them lacked the requisite commercial experience. As time went on the majority of them disappeared from the scene, and most of the small and medium-size air cargo companies ceased operation. Even the air freight boom during the Korean War did not radically alter the general position.

On the other hand there was some satisfaction to be drawn from the annual reports of the scheduled airlines, who were able to announce yearly increases in their air cargo, which was building up satisfactorily and developing into an increasingly remunerative line of business. But this was surely a logical development? After all freight accounts for the major portion of the revenues of railway and shipping companies. The cargo business had put Norwegian merchant shipping among the world's leaders until immediately before the outbreak of World War II, and had played a decisive role in the country's balance of trade. There was another point: compared with passenger travel, the cargo business was much less subject to seasonal fluctuations. Typical of the attitude at that time was the expression coined by an enterprising air cargo carrier, "We carry everything but giraffes."

In one of his more ironical moments our friend, the late C.G. Grey, founder of "The Aeroplane", described the passenger as the most inconvenient piece of cargo it is possible to imagine. He demands a comfortable seat, thus taking up much space, and requires service, food and entertainment (C.G. Grey had not then foreseen that a few years later the passenger's demands would extend to beds, seven-course meals, cocktails, champagne, caviar and orchids, even a lounge aboard the aircraft). There was only one way to make air travel pay, he said. All passengers should be given a little injection before take-off to put them to sleep. They could then be packed like sardines. At the other end another injection would revive them ready for the trip from the airport into town. When the "most experienced airline" advertises orchids and a dinner by Maxim's it is not exactly following our English friend's advice.

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"We carry everything but giraffes . . ." Air France does not seem to recognize this limitation, though admittedly the giraffe here is very young.

In the present issue the reader will find a report by a member of the *Interavia* editorial staff on freight operations over the North Atlantic. He is also presented with a review of the general situation in the American domestic air cargo market and with an analysis of air freight activities in Europe. It may be claimed that none of this is very exhaustive, but it does provide the layman with an overall impression and the operator with food for thought. Certainly the air cargo picture is not bright at the moment.

That this criticism is not too wide of the mark is borne out by the remarks of Sir William P. Hildred, Director General of the International Air Transport Association, who told the last IATA Annual General Meeting in New Delhi in October 1958 that "The potential is there, but we must forge the key that will get us through the door..." Is this key really so difficult to find?

In Hildred's view, what is needed is a vast educational programme to convince the airlines on the one hand of the importance of air cargo, and the potential customer and shipper on the other of the advantages of sending their goods by air. This may not be too easy, as...

❶ At the moment the time required for transporting goods to and from the aircraft and for general ground handling is so long that in some cases it more or less balances out the time saved in the air. Compared with the collection and delivery of goods for transport by rail or sea, the time wasted on the ground plays a much more important part in air cargo operations.

❷ This is partly due to the fact that freight is subject to the particular attentions of the Customs authorities, who—like all official agencies—have their fixed working hours and their fixed regulations, in brief their official machinery. This machinery thus becomes enemy No. 1 of air cargo, and such "red tape" does not exactly help sales promotion.

❸ That air freight is dearer than rail, road or sea transport is obvious, since speed must be paid for. During the course of time IATA has collected together whole volumes of air cargo rates, granting reduced tariffs for given quantities or categories of freight. Though IATA is often accused of being no more than a cartel designed to keep up prices, it cannot be denied that in the matter of air cargo it has made genuine efforts to make rates economic and to encourage customers to send their freight by air. If only the actual freight rates were the sole cost item involved! But...

❹ There are the international agencies and forwarding agents on whose "good offices" the airlines are dependent for at any rate a large proportion of their passengers and freight. These agencies and forwarding companies are so to speak the air transport industry's No. 1 customer and understandably enough the industry handles them with kid gloves. But they are also, of course, good businessmen, who in presenting their accounts to shippers and consignees try to show how much work each article of freight makes for them.

The consignee has the following items to pay for: various charges on arrival; formalities during the Customs examination; declarations and so on for sales tax; transport into town and to domicile; telephone calls, more forms, more stamps and correspondence. In addition there are Customs duties, sales tax, etc. to be paid.

The consignor also faces a similar situation. The result is that in addition to the actual charges for air freight there are many other payments which have to be made to agents; in the case of small shipments these may amount to as much as 50 percent of the transport rates.

❺ When it comes to handling air freight, the airlines' fleets today suffer from the weakness that they are composed chiefly of high-speed, luxurious and costly passenger aircraft, as up to the present passengers and not freight have been the airlines' customer No. 1. Leaving aside the few all-cargo aircraft operated by the scheduled airlines, freight is generally used as fill-up load in these costly passenger aircraft and is so to speak taken on sufferance. For mail this is understandable, since even express trains and high-speed liners also carry letters and small packets. For freight it is less logical, as the railways use chiefly goods waggons and the shipping lines mostly cargo boats for this purpose. This takes a bit longer, but is cheaper. Since, as mentioned earlier, air freight suffers considerable delays on the ground, it is immaterial whether it crosses the Atlantic in seven hours in a jet aircraft, or in ten to fifteen hours in a slower piston-engine or turboprop transport. Probably the latter would be more economical.

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If *Interavia* has enumerated some of the weaknesses inherent—if we are not mistaken—in the manner in which air freight is normally handled today, this is not out of any negative desire to drag the freight experts' sins of omission into the open. On the contrary, our primary object is to take a positive part in the search for the key to the air freight market recommended by Sir William Hildred. The following are our suggestions for improving the present situation:

1. Air freight handling on the ground, i.e., from the consignor to the airport, and from the airport to the consignee, must be greatly speeded up, if the advantages of air transport are to be maintained.

2. The Customs offices at all Customs airports should remain open 24 hours a day to handle air freight.

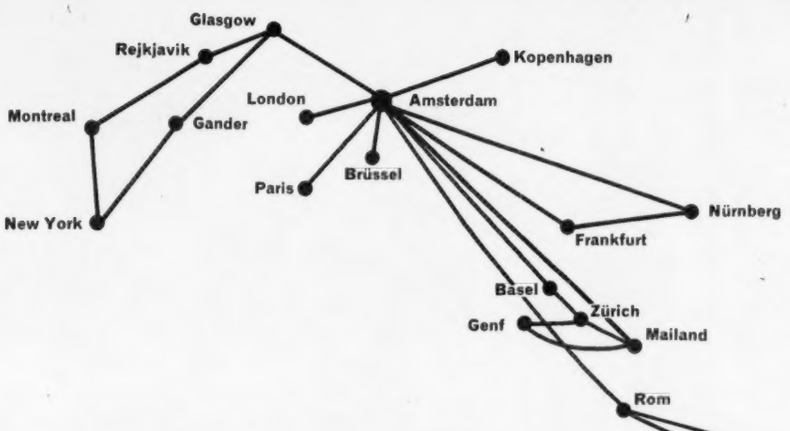
3 & 4. The system of subsidiary charges by forwarding agents should be reduced and standardized by negotiation or regulation through IATA. Agents should organize faster and more frequent collection and delivery services.

5. In all air-faring countries the commercial aircraft fleet would immediately be requisitioned for military purposes in the event of mobilization, like the railways' rolling stock (including goods waggons) or the fleet of merchant ships, including cargo boats.

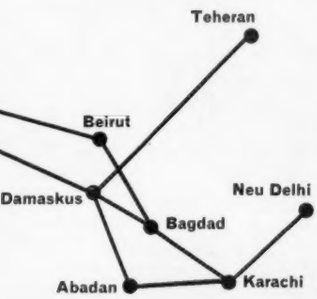
It is therefore incomprehensible why governments have hitherto shown themselves to be so little interested in building up adequate reserve air fleets; not every country has so extensive or so powerful a transport air fleet as the United States or the Soviet Union. If the governments of the air-faring nations would make available to their national airlines in peacetime an adequate number of cheap transport or freight aircraft against low rental payments—or even without charge—they would have a ready-made transport reserve, complete with aircrews, in the event of war. What is more, this gesture would do a very great deal for trade and commerce, for the aircraft industry and... for international air transport! Air freight could be made cheaper, air freight users would vastly increase in numbers, and the airlines would see their revenues grow beyond recognition.

The pre-war Imperial Airways used the slogan: "Time flies, why don't you?". Since then twenty years have gone by... But freight has still not got off the ground. EEH

Sample collection of forwarding bills for air cargo consignments to and from the airport.



Route network for KLM's freight services



Aboard a KLM Freighter

A Personal Account by Peter Hausheer, Interavia, Geneva

"Have you ever tried Irish coffee?" asked Jack Sweeney during a pause in his talk of Elizabeth Arden's and the Ali Khan's horses. We were standing by the green-painted box of an Arab mare who was confidently nuzzling the palm of my hand. The smell of fresh hay and horses reminded me of riding school: the extended trot, long canters, figures of eight and flying changes... By another box stood Jan Fokkema, talking soothingly to an Arab stallion whose speciality was to snap at everything which came within his reach. A board had to be fixed on the front of his box before we could walk safely down the narrow space between the horses. Presently Arthur Todd came picking his way down this gangway, balancing two cups of hot coffee; not Irish coffee yet—for this I had to wait another hour. As we were settling down comfortably on bales of straw and packing cases, Johan van Bremen came into the stable and told us we would be landing at Shannon in an hour and loading some more horses. Van Bremen was the captain of the KLM freighter PH-LKL "Desiderius Erasmus", a *Super Constellation,* in whose roomy, pressurized freight hold we were just flying over Liverpool...

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At 10 a.m. on Sunday, December 14th, 1958 I found myself standing with L. Ch. van Eeghen, of the KLM Public Relations Division, in front of the freight hangar at Schiphol airport. Parked on the apron was the Lockheed L-1049H *Super Constellation* of which I was to form part of the cargo a few hours later. This was one of three *Super Hs* which KLM has in service. Shortly before I had clambered with my small suitcase up the ladder into the flight deck and taken up my quarters in the freight hold: a comfortable first-class chair wedged between boxes and packages, all firmly anchored to the floor by nets, cables and harnesses. The rear portion of the hold was still empty, and I had idly wondered what it was ultimately to contain. The freight door was raised, and through the gaping aperture I could look out and see van Eeghen far below. "You're to have distinguished company," he called up to me, "two thoroughbred Arab horses... stallion and mare... going to New York for stud purposes..." So that was the reason for the empty space in the hold and the padded gangway being brought up to the aircraft. Although horses are by no means an unusual cargo for KLM—the company has already transported more than five hundred to all continents—it was a lucky chance for me that flight KL 65 should just happen to be carrying horses. So I hurried forward, squeezed myself through the narrow door of the flight deck, climbed down the ladder and posted myself with camera at the ready beside the aircraft.

Soon a spirited chestnut, with light-coloured tail and flying mane, came trotting out of a large tent. A fiery mare, whose hooves barely touched the ground. Led by a KLM employee, she approached the ramp, hesitated a moment and then began playing up. As soon as she was led away from the ramp she quietened down, but shied away again when brought back to the narrow gangway leading into the dark freight hold. Neither coaxing nor the strenuous efforts of three strong men could persuade the creature to take even one step up the ramp. "Horses are like men. When they once get an idea into their heads, it's a devil of a job to get it out again..." With these words a beanpole of a man in a grey raincoat turned to me: Jongejan, head of KLM's freight service. His trained eye took in the situation at a glance. What was required here was patience—and a minor strategem. "Fetch the stallion first," he called, "let's see if he goes up." He went up as good as gold, as if he were going into his own stable. The mare watched the proceedings, and then prepared to follow the stronger sex; meekly and well-behaved—as if she had not held us up for at least an hour and a half through her whims. While the horses were being settled in their boxes and secured by means of leather-padded harnesses passing over their backs, Jongejan took me on a tour of the KLM freight section at Schiphol.

The first air cargo consignment arrived at Schiphol airport almost 39 years ago, on May 17th, 1920, aboard the KLM aircraft which inaugurated the London – Amsterdam service. It consisted of a packet of English newspapers and a letter from the Lord Mayor of London to the Mayor of Amsterdam. Since then the "Flying Dutchmen" have carried thousands of tons of freight. Though limited to only a few types of goods before World War II—flowers, fruit, newspapers and high-value articles—air cargo has experienced a tremendous upsurge since 1945. The total of some 25,000,000 lb. of cargo carried in all the pre-war years had already been far exceeded by 1954, when roughly 40,000,000 lb. had been carried.

Since 1952 KLM has had a modern freight building at Schiphol airport, designed to ensure rapid, rational handling of cargo of all kinds. The spacious sheds are stacked to the roof with freight: machinery and other heavy industrial goods, precision instruments, pharmaceutical and chemi-

One of KLM's "Flying Dutchmen", a Lockheed L-1049H *Super Constellation.*

cal products, watches, products of the clothing or plastics industry, jewellery, precious stones, bars of gold (in a triple-locked strongly guarded room—strictly no admittance), flowers, etc. Heavy goods rest on pallets, which are fork-lifted into the freight hold. Lighter items travel by conveyor belt direct from the store into the aircraft. Enthusiastically, Jongejan described to me his plans for still further improvements and rationalization. The large tent (needless to say with heating and neon lighting) in which particularly bulky items—and sometimes animals—are now housed, is to be replaced by a new hangar.

My tour of the freight department ended with a visit to KLM's "Dierenhotel", or animal hotel. On this particular day the number of guests was modest: a few dozen canaries, several dogs. But the pictures show what it looks like in the high season. On an average over a million guests stay here every year: dogs and cats, kangaroos, sea lions, pumas, lion cubs, panthers and wild boars, hippotamuses, penguins and porcupines, starlings, hornbills and finches, flamingos, cranes and chimpanzees. The oldest guest so far was a 300-year-old tortoise...

Early experience of transporting live animals led to the preparation of a "Manual for the Carriage of Live Animals", which for example recommended that "hippopotamuses, rhinoceroses and elephants should not be carried in passenger aircraft." It also warned personnel that cranes had the shocking habit of pecking at shining objects, such as eyes. Page 19 described what to do if animals broke out, and page 16 stated "when monkeys are being transported, the cages should be inspected occasionally, and the animals should also be talked to." Today KLM's animal transport service is based on scientific foundations. Doctor J.C.W. Hesse, a veterinary surgeon associated with Utrecht University, has been commissioned by KLM to take part in many animal flights during recent years to observe the behaviour of the various passengers. Oxygen content and humidity of the air in the freight hold were measured, and a special investigation was made of whether fish suffer from air sickness. Originally fish were carried in tins, but they are now put into plastic bags, three-quarters filled with water, and suspended from the roof of the hold. Moreover, KLM has developed special cages for birds and other animals, in collaboration with the Netherlands Society for the Protection of Animals.

Care and feeding are in the hands of a specially trained staff of animal stewards, who are responsible for their charges not only in flight but also during intermediate landings. Trained at a zoo, these men are familiar with the peculiarities of almost all species of animal. For example, they have discovered that elephants are very well behaved as passengers if they are accompanied by a hen. Since this surprising discovery elephants in transit at the Animal Hotel always get a double room, and the hen has earned the honorary title of "elephant girl". However, the problem of transporting full-grown giraffes has still not been solved...

High season at Schiphol's "Dierenhotel".

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After an excellent lunch in the airport restaurant, I experienced the honour of being called as the only passenger for flight KL 65. "Desiderius Erasmus" was ready for take-off. I hurried to the aircraft through the rain, clambered on board and fastened myself in my seat. Behind me Fokkema and Todd were standing by the two horses, gently stroking their necks. I turned round to watch the animals; they were extraordinarily quiet, though as the engines roared into life they laid back their ears and raised their heads. We taxied down the runway, lifted off, climbed to cruising altitude and set course for Shannon. Below us was a grey sea of cloud, above us blue sky and brilliant sunshine.

I settled down comfortably, took off my coat and jacket and slid into an old pullover. My diffident question as to whether smoking was permitted in a freight aircraft was answered by a friendly nod. Gradually we got into conversation, and soon the comfortable "stable atmosphere" mentioned above was created. As we were already nearing Shannon, I had no opportunity for the moment to talk to the cockpit crew.

Ireland came into view (the window next to my chair had been considerately relieved of its plastic protective cover, whose small holes allowed light to penetrate into the hold but did not offer any view outside). I peered downwards and could just make out the Emerald Isle's patchwork of fields and meadows, divided off by low hedges. A slight pressure on my ears told me we were going down ready for landing. I fastened my seat belt and put out my cigarette, while Fokkema and Todd took up station near the horses. Jack Sweeney, an old hand aboard freight aircraft, refused to be disturbed and began hunting around for his tam o'shanter. This was his great pride, and he parried the jibes of his friend Todd with true Irish spirit, although he has long been an American citizen.

*

It was twilight by the time we touched down at Shannon. We climbed down and marched across the wet apron to the airport building. While the crew disappeared into their service quarters, Sweeney steered me through the restaurant and the tax-free shop to the bar, where he was evidently an old and welcome guest. After a first whiskey and some hesitant questions about where I came from and what I was doing on the trip, he thawed out completely: his world revolves around horses. "Groom" was the modest title he claimed for himself, but he is much more: a

Freight, grouped according to country of destination, stacked up in KLM's stores at Amsterdam–Schiphol airport (left). New York International cargo centre: four long blocks of buildings (foreground) house 27 airlines. Centre, trucking companies' block and small building (white) for the accommodation, inspection and care of animals. In the rear is the control tower and the International Arrival Building.

The ant-eater, a rare guest from South America.

The "Dierenhotel's" oldest guest so far was a 300-year-old tortoise.

great friend of horses and almost always travelling somewhere with them. He was also looking forward like a child to the Christmas decorations on Broadway. "There's nothing like Christmas on Broadway," he told anyone who would listen to him. As we were drinking our second glass, a smiling young woman sat down on the stool next to me and introduced herself as a member of the Shannon Airport Publicity Department. "Tried Irish coffee yet?", was her first question. By now I was beginning to get curious and was easily persuaded to order this wonder drink. It tasted pretty good. The recipe? A little strong coffee, a lot of Irish whiskey, three lumps of sugar and whipped cream. The secret is to stir the sugar in well before adding the cream, so that the hot coffee and whiskey can be sipped through the cool cream!

After a tour of the tax-free shop (the prices were really attractively low) we made our way to the pilots' canteen for supper. So as not to overload my stomach I decided a sandwich would fill my needs. What came was half a roast, snugly bedded between two plate-size slices of bread, toasted golden brown. I'll call back for the other half of it next time...

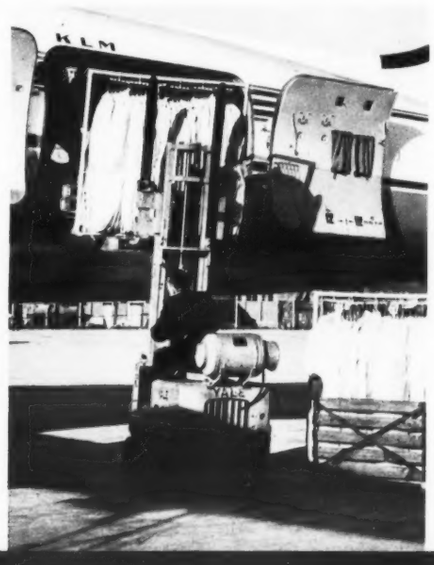
Our travelling companions had meanwhile been increased by the addition of two dark brown Irish riding horses and two foals. By now the *Super H* hold was so full that one had to be almost an acrobat to get to the galley and washroom in the rear of the aircraft. After some practice I became quite adept at picking my way among the cables and harnesses, straps and chains on the floor, balancing a mug of coffee in one hand and a plate of bread and sausage in the other. By this time we were five hours out across the Atlantic on the way to Montreal, our next port of call. The ceiling lighting in the hold had been dimmed, the horses were contentedly dozing, and Sweeney had vanished beneath a pile of blankets and was snoring. Fokkema and Todd were reading, from time to time looking up towards the horses or checking the fastenings of the heavy freight. I tried to bring some order into my thoughts and sort out the impressions of the past twelve hours.

Presently Captain van Bremen came along and invited me to try the co-pilot's seat. I eased myself into position, with the joystick between my knees, examined the shining instrument panel and tried to familiarize myself with the *Super Constellation's* flight deck. "If you can read, you can fly," said the second pilot, who had moved over to the captain's seat. My nod cannot have been very convincing, for he immediately began to explain to me the meaning of every lever, switch and instrument before, above and next to us. Through the windshield I observed the star-filled night sky and the cloud formations moving up towards the aircraft. In greatly reduced scale they had already been visible on the radar screen. Our task was to pick out the calmest route among the turbulent zones. A slight twist of the button on the autopilot was sufficient to turn the aircraft into the new course and hold it there. The denser and more menacing the clouds, the more fascinating is the game. Behind the wall of cloud to my right ghostly flashes suddenly appeared, shooting upwards and outwards until the whole horizon was hung with a floating veil. Northern lights... There was a rustling and crackling in the earphones with which I was following communications between us and an ICAO weather ship in the Atlantic, and a glaring lightning flash tore through the black wall of cloud. But our aircraft was quietly pursuing the course selected on the radar screen and soon passed smoothly out of the storm zone into the clear night sky.

*

Intermediate landing in Montreal. The airport lay under a thick blanket of snow; temperature 5 degrees Fahrenheit. Shivering in our light coats we clambered out of the open freight door and rode down the conveyor belt into the open. The frozen snow crunched beneath our shoes. After a minimum of formalities we were driven in heated cars to the transit building, where despite the early hour—it was three o'clock in the morning—a copious breakfast was awaiting us. We had a bare two hours in Montreal, where some of the freight was off-loaded, and then set course for New York, still with our horses. By daybreak we were within sight of the lights at Idlewild Airport, and very soon we had touched down and were rolling towards the terminal. The trip was over. But before going further I should like to take this opportunity of thanking Captain van Bremen, Flight Officers Verafeld and Spykerman, Flight Engineers Koops and de Vries and Animal

Anything from the smallest packets to the heaviest machinery parts can be carried by air. Loading freight aboard a L-1049H *Super Constellation* at Amsterdam-Schiphol. Cost-saving packing: clothes packed on hangars and protected by plastic bags are carried into a Douglas DC-6A (lower right).



Stewards Todd and Fokkema for the generous hospitality they showed me aboard the "Desiderius Erasmus".

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For four days I remained on terra firma in New York, days filled with rubber-necking—Empire State Building, U.N. headquarters, Central Park, Fifth Avenue—visiting the *Interavia* office, KLM, American Airlines and the Port of New York Authority, and with endless taxi trips, the best way of getting about in an unfamiliar city. It was bitterly cold, and the many decorated and illuminated Christmas trees in the streets and squares were shaken by an icy wind...

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A well-known Swiss watch manufacturer once inquired whether it would be cheaper to send a consignment of watches, weighing 20 kg and valued at $25,000, to Singapore by air or by surface. Making allowance for insurance, packing, freight charges and duration of trip, the KLM freight expert arrived at the following result: costs by surface would be 1,825.05 Swiss francs, by air 1,001.30 francs. Time in transit 45 days by rail and ship, only 4 days by aircraft. The biggest differences were found in insurance costs (1,099.75 francs by surface, 530 francs by air), in freight charges (24.40 by surface, 381.00 francs by air), and in the loss of interest during the trip (662.40 francs for surface, 58.80 francs by air). Packing costs are negligible for a small parcel of watches.

This was one of the examples which Arthur J. Rickard, KLM's Cargo Traffic Manager for the United States, used to convince me of the advantages of air freight. Sales promotion experts are on the move daily, canvassing new customers for air freight, and massive advertising campaigns are devised to make businessmen and industrialists, exporters and importers air cargo minded. The main arguments are always saving in time and low insurance and packing costs, increased sales due to a speedy supply service and mimimum costs for storage. In most cases the advantages of air cargo are abundantly clear.

Clifford G. Evans, head of the Aviation Development Division, Port of New York Authority, also talked about air cargo rates and charges: international rates (general and specific) are computed on a per pound basis for airport-to-airport carriage. Shipments weighing more than 100 lb. enjoy a 25 percent reduction on general commodity rates. In addition, special rates have been agreed for a wide variety of specific commodities. For example, the carriage of 100 lb. of finished textiles from New York to London costs $50.00 (specific commodity rate 50 cents per pound), compared with $91.00 (general rate 91 cents per pound) for commodities for which no specific rates are in force. High-value shipments (worth at least $7.48 per pound) are subject to valuation charges ranging from 10 cents per $100. Rates do not cover pick-up or delivery charges, which are calculated separately on the basis of special arrangements between airlines and trucking firms. In the New York area, for example, the basic rate is 80 cents per 100 lb. But enough of rates and charges.

Goats are not so capricious as horses; they can be loaded by fork lift.

Elephants are most well-behaved passengers – when accompanied by a white hen . . .

*

Over lunch in New York Jon P. Brouwer, of KLM's Public Relations Department, told me the story of the cattle lift to Katmandu, Nepal: 16 heifers, 4 bull calves, 57 sheep and 5 pigs, a gift from the people of America to the people of Nepal, flew from New York via Amsterdam, Rome, Damascus and Dhahran to New Delhi. There the animals were loaded onto a convoy of trucks and arrived in Katmandu six days later. The animals and their human companions, including Jon Brouwer and Jan Fokkema, whom I knew from my flight to New York, drove only at night, resting during the day. Such a transport problem obviously requires careful preparation and is not encountered every day.

At American Airlines, KLM's U.S. interline partner, our conversation with S.F. Leib, Manager Interline Airfreight Sales, turned more to technical questions concerning packing, loading and freight aircraft. His special pride is the Paul Bunyan Box developed by American Airlines, a water-tight aluminium container on coaster wheels, which greatly simplifies loading and unloading. Incidentally, Paul Bunyan is a legendary American figure, a good-natured giant, said to be sixty-three axe handles high, who was always willing to lend a helping hand wherever needed.

On my second visit to KLM's New York office I ran into Rein J. Vogels, Director of Public Relations, in the doorway. It was his generous help which had enabled me to make the trip at very short notice. After a brief conversation he hurried off, a Christmas parcel under his arm, wishing me all the best for my return flight.

Soon my stay in New York drew to a close. In the early evening I was again standing in front of the Idlewild Terminal Building, where Gary Lutgendorf picked me up in his car. We drove over to the airport's freight centre, which was

Our friend, the Arab mare, goes aboard. (At least she looks as if she would – just after this she turned stubborn . . .)

"When monkeys are being transported, the cages should be inspected occasionally and the animals should also be talked to."

built in 1956 at a cost of $5,300,000 and covers an area of 80 acres. Four long buildings house the air cargo services (administration, storage rooms, loading vehicles, etc.) of 27 airlines. In addition there is a 2-storey block with accommodation for the many trucking companies which serve the airport, as well as individual customs and checking services, and finally a building where animals are housed, inspected and cared for.

After nearly two hours touring the store rooms (divided into export and import sections) and the trucking companies' building—in every office a gaily decorated Christmas tree was lit up—Lutgendorf drove me to the recently completed International Hotel on the edge of the airport zone. We consumed a hearty supper in the ultra-modern restaurant against a background of soft lighting and sweet music. We sat talking until 10.0 p.m. when Lutgendorf drove me back to the International Terminal Building as he had to return to his work. As I had an hour and a half to spare, I was able to make a thorough inspection of the Terminal Building for the first time. But then my time was up and I went along to the KLM office on the ground floor where I had the pleasant surprise of running into old acquaintances Arthur Todd and Jan Fokkema. They were again to be members of the party. Here too I was introduced to the aircraft crew, Captain G. Burger, Flight Officers H. March and J. Koppellman, Flight Engineers P. Wallart and G. Lammertse. Once again I was made heartily welcome. We all drove together along the concrete road to the freight centre. Incidentally it is a strange feeling to be sitting in a car which is held up by a red light to let an aircraft cross the road.

Aboard the PH-DFB *Generaal Snijders*—this time a DC-6A—I was immediately assailed by a somewhat penetrating smell. Following my nose I discovered eleven wire cages containing adorable little grey and white animals. At first I thought they must be guinea pigs and poked a friendly finger through the wire mesh. Immediately one of the adorable creatures darted forward and bored its sharp teeth into my flesh. Such vicious little things could only be minks. And indeed we were carrying live fur coats! Besides these creatures there were six sleepy dogs and a vast quantity of other packages, all again stowed according to an exact loading plan and secured by strong nets. In among large cases and packets I discovered a flat brown cardboard box from which suspicious scratching noises emerged. From the label I learned that these were "baby tortoises for medical research". Having seen in KLM's hangar at Idlewild a box of meal worms (marked as "fish food") which had arrived by air from Europe, I was no longer surprised at anything...

Intermediate landing at Montreal and new guests, this time chinchillas and more dogs. As well there was a good deal more freight, so that once again there was not much room to move about. Despite the whistling of the minks, the snoring of the dogs and the scratching of the baby tortoises, I managed to get a little sleep. Our next target was Gander in Newfoundland. The light of a new day coming in through the barred windows woke me up. I stretched my cold, stiff limbs and fetched myself a mug of hot coffee from the galley. On the way back I met Captain Burger who told me we should be landing at Goose Bay, Labrador, as Gander was fog bound. We were therefore taking a more northerly route.

Minks in the rear of the DC-6A.

America is beginning to take an interest in European "bubble" cars...

Freight is tied down by strong nets and harnesses. The tall case contains valuable pictures from France...

Taking nourishment high above the Atlantic. Arthur Todd in the foreground, Jack Sweeney left, behind him Flight Engineer Peiter J. de Vries.

It was 8.30 a.m. local time when we landed at Goose Bay. Not far from the airport buildings were a few U.S. Air Force transports, but otherwise there was little sign of life. As we left the aircraft the silence was shattered by the scream of a jet fighter being started up. Presently it disappeared in a whirling snow-cloud, skimming over the low fir trees and beyond the horizon of this bare and unfriendly region. At a temperature of minus 13 degrees Fahrenheit we hurried with chattering teeth across the apron to the grey-green building. Just as I was beginning to fear my nostrils would get iced up we reached the small door leading to the pleasantly heated canteen. There was more hot coffee and small slices of a delicious fruit cake. We sat down in comfortable tubular steel chairs by a low round table and unanimously decided to spend our next vacation in Goose Bay. A case on the wall contained leaflets issued by Trans-Canada Air Lines, the only airline to my knowledge which operates regular services to this godforsaken spot. The leaflets invited us to fly to the sunny paradise of the Caribbean Islands! Outside in the shivering cold men wrapped in thick furs were busy refuelling our aircraft. After a brief half hour we climbed back on board and took off over the desolation of Labrador. Later I caught a glimpse of the Atlantic glittering in the morning sun and of a few icebergs.

For nearly two hours I sat in the flight engineer's seat—in the DC-6A it is set back slightly, between the pilot's and co-pilot's seats—and followed the crew's battle against time and weather. Our flight plan called for a last intermediate landing at Prestwick, where we were to take on fuel for the flight to Amsterdam; weather conditions and in particular the strong headwinds made it unlikely that we could fly non-stop from Goose Bay to Amsterdam. As time went on however the weather reports improved considerably and there was a reasonable hope that it would not be necessary to land at Prestwick. We had been underway for nearly 20 hours and were all beginning to long for a comfortable bed. The navigator and flight engineer repeatedly compared the results of their readings and computed whether our fuel supply would suffice for a non-stop flight to the home airport.

Around midday we refreshed ourselves once again with hot coffee and sandwiches from the galley. Incidentally KLM had made excellent provision for the PH-DFB's only real passenger: there was not only coffee, tea and tomato juice on board, but also whiskey, beer and Holland's gin. As I did not wish to be favoured above the crew I stuck to coffee, though towards the end of the trip I did take a beer. Later Jan Fokkema presented me with the little pocket flasks of whiskey and gin as a parting gift.

After lunch I sat down again in my first-class seat among the animals and for the first time managed to fall fast asleep. When I woke up again it was already ten o'clock in the evening. Nobody mentioned Prestwick again... we were heading straight for Amsterdam.

Air Freight

European Air Freight without Illusions

When chemicals ran out during an epidemic of sugar beet and fruit tree disease Lufthansa carried four aircraft loads of Metasystox to England. The shipment was collected from the Bayer plant at Leverkusen at 6.30 a. m. and flown straight from Dusseldorf to London, so that spraying could begin the same evening.

Wheatcroft versus Freight Specialists

Textiles, medicines, snakes, pianos, cars ... the range of goods that can be carried by air freight is, as we are always being assured, nearly unlimited. Whether or not freight operations pay, is another question.

The present importance of air cargo traffic in the European airlines' total operations is clearly outlined by Stephen Wheatcroft in "The Economics of European Air Transport".[1]

Of the total 368 pages of his well-known book Wheatcroft has devoted only six to air cargo, giving the following reasons for his "cool" treatment of the subject:

"There are two reasons why the emphasis of this study is upon the status and problems of passenger operations. In the first place, the revenues of the airlines at the present time are predominantly derived from this class of traffic and the European industry is, in fact, largely a passenger carrying business. In the second place, it is believed that the basic economic problems of the industry, because its major source of income is from passenger traffic, can only be solved if this side of the business is put on a sounder basis.

"This approach to the problems of the airlines will inevitably evoke the wrath of the enthusiasts of air cargo development who will reply that the present share of cargo revenue to the total revenues of the European airlines has no relevance to the future contributions which this type of traffic may make. This may indeed be true, and it may even be that cargo traffic will eventually become, as it is in other forms of transport, the predominant source of revenue for the airlines. But this is not the present issue. The reason for the neglect of air cargo problems in this study has no connection with visions of how important air cargo may become in the future but only with an assessment of the contribution which it can make towards solving the problems of the present. It is suggested that *no development in air cargo traffic could, in the immediate future, overcome the problems which the airlines now face.*"

Air Cargo Analysis, 1953–1957 published by the Air Research Bureau

A few months before Wheatcroft had completed his book, the Air Research Bureau, Brussels[2] published its first report on the development of intra-European freight traffic between 1948 and 1953.

[1] In 1946 Stephen Wheatcroft, who served during the war as a pilot in the Royal Navy's Fleet Air Arm, was appointed Economic Adviser to BEA and subsequently joined the Commercial Department as manager in charge of tariffs, commercial research and planning. He was also for a number of years a member of the BEA delegation to the Traffic Conferences of IATA.

[2] The Air Research Bureau, Brussels, works for the following companies: Aer Lingus, Air France, Alitalia, BEA, Deutsche Lufthansa, Finnair, Iberia, Icelandair, KLM, Sabena, SAS, Swissair. The ARB report is entitled "Intra-European Air Cargo Traffic 1948 – 1953."

An SAS DC-6B picks up two Van Gogh paintings at Tokyo-Haneda Airport for a trans-Arctic flight to Amsterdam.

In mid-January 1959, when the Presidents of twelve European companies met in Barcelona for a meeting of the Air Research Bureau, they were presented with the second ARB report on air cargo operations, covering the years 1953 to 1957 . . .[3] It is hardly likely that Wheatcroft would change his views on reading the new ARB report.

To get an idea of the size of air freight volume on a world scale, the ARB report compares the ton-kilometres recorded for passenger, freight and mail operations by ICAO for the past ten years:

World Air Traffic Development, in millions of ton-kilometres

	Passengers	*Freight*	*Mail*
1947	1,710	270	130
1950	2,520	770	200
1953	4,140	1,050	280
1954	4,670	1,130	330
1955	5,440	1,330	380
1956	6,260	1,510	410
1957	7,210	1,680	440

The average yearly increase in freight traffic for the ten-year period 1947 to 1957 was 21%, whereas passenger traffic showed an increase of only 16%. However it must not be forgotten that the rate of growth in air freight traffic is continually slowing down, and in the last four years – following the end of the "Korea boom" – has lagged behind passenger traffic development:

Average increase per year

	Passengers	*Freight*	*Mail*
1937—1947	+ 29%	+ 34%	+ 18%
1947—1953	+ 16%	+ 25%	+ 14%
1953—1957	+ 15%	+ 13%	+ 12%

If these figures for world air traffic give cause for concern and suggest that caution should be applied in assessing the future of air freight traffic, the modest volume of European freight business is even more obvious when compared with American traffic:

Millions of ton-kilometres, 1957

	Passengers	*Freight*	*Mail*
Europe	548	87	29.2
USA	3,691	618	144.3

European air cargo traffic represented 4.8% of the world total in 1953, and 5.6% in 1957.

And the picture is completed when it is seen that the percentage of freight traffic in the total income of Europe's scheduled airlines is steadily decreasing. The following table shows the figures for the ARB companies, whose results are representative of European air transportation.

Total freight revenue of the ARB carriers

	Revenue in millions of US $	*Percentage of freight revenue to passenger revenue*
1953	9.70	11.4%
1954	10.64	10.8%
1955	12.13	10.0%
1956	14.34	9.8%
1957	16.21	8.9%

In the same period the mail revenue percentage of the ARB carriers decreased from 6.4% to 5.1%.

Freight operations as a stop-gap

These figures reveal that there is something wrong with air freight operations. What?

[3] "Intra-European Air Cargo Traffic 1953 – 1957."

The ARB report neither makes open criticism of the present-day situation of air freight operations, nor does it state clearly where and how improvements should be made. However it does contain several points from which one can plainly extract the reasons for the decline.

First, it can be seen that 80% of the freight ton-kilometres come under mixed traffic (passengers and freight), while only 20% belong to pure freight traffic. Further it is shown that the freight load factor in mixed traffic is abnormally low—for the years 1953-1957: 31.5%, 23.9%, 27.7%, 25.8%, 23.6%. Finally the following factors are held responsible for this low load factor level:

"The capacity available for cargo transportation on passenger aircraft is not, in general, regulated according to the needs of the cargo operation but is a by-product of the passenger operation. Passenger services are introduced or augmented, new aircraft types are introduced and the configurations of aircraft changed primarily according to the needs of the passenger market.

"Cargo capacity is affected by the level of the passenger load factor.

"There are considerable disparities in the directional flows of cargo traffic.

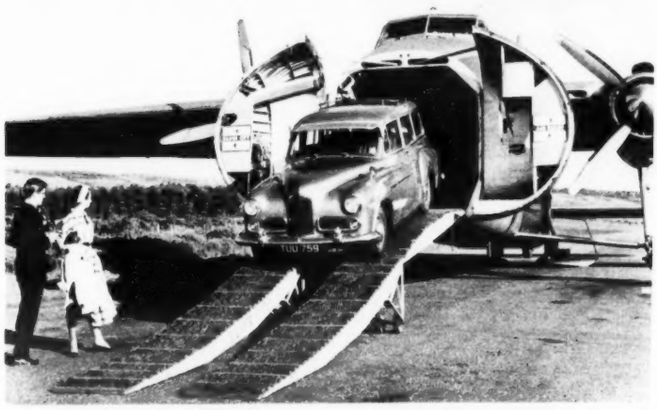
"The sizes and strengths of the cargo compartments of passenger aircraft limit the type of load that can be carried with regard to size and density."

With this the main point is laid down, even if the ARB report continues in a quieter tone:

"Under these conditions it is extremely difficult to achieve a high 'cargo load factor' and the load factors quoted in the above table should not in any way be compared with the level of load factor which is normally achieved for passenger traffic."

Putting it bluntly this can only mean that at the present time most of the freight operations are so organized that empty space in passenger airliners is filled up with every piece of freight found lying around at the airport.

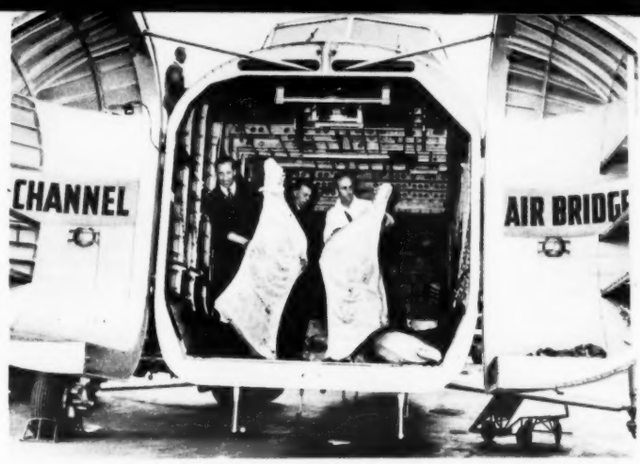
Not only in Europe, but throughout the world, freight operations are regarded only as a stop-gap. They receive little attention in either fleet or organizational planning, and are noticed only when they bring disappointing results.



Silver City Airways' car ferry service enables the cross-channel journey to be made in less than one-and-a-half hours, including all handling and documentation. By comparison the sea crossing can occupy a whole afternoon.

At the IATA Annual General Meeting in New Delhi in October 1958, Sir William P. Hildred, IATA Director General, compared air freight operation with an anaemic child in need of powerful vitamins: really suitable, pure freight aircraft; proper freight terminal buildings at the airports; time-saving handling and stowage methods (a freight consignment travelling at hundreds of miles per hour should not need a whole afternoon to move 50 yards on the ground); attractive rates; market analyses, sales promotion and prompt delivery services.

"The potential is there," said the IATA Director General, "but we must forge the key that will get us through the door. And the key, to my mind, is an intensive educational campaign to convince ourselves of what air cargo can do for us, and to convince prospective shippers and consignees of what air cargo can do for them."



Air cargo represents one of the chief sources of income for the independent carriers. Britain's Air Charter Ltd. carries a load of meat from Rotterdam to London.

Baltic Air Market and Charter Operators

The fact that the accompanying short analysis of European air freight is mainly limited to discussion of the scheduled air transport operators is perhaps understandable when it is remembered that these operators enjoy by far the greater proportion of the freight business, and their statistics are more complete than those available on the independent operators. However, it would be very misleading to ignore the activities of the considerable number of private air transportation companies who find one of their main sources of business in the air freight market, and who are doing everything in their power to bring new life into this field.

In the early post-war years when the Western powers were maintaining large contingents of troops overseas, and at a time when the European economy was being redesigned and, so to speak, re-established, the demand for express freight transportation reached an extraordinarily high level. In Europe, as in the United States, there was feverish activity in the formation of new companies. Month after month new names appeared in the companies register, particularly in Great Britain where the charter market had already become established in pre-war days in Baltic Exchange dealings, in the hands of the Air Section of London's *Baltic Mercantile & Shipping Exchange Ltd*.

Interavia reflected the general enthusiasm then prevailing by the publication of a detailed article on the activities of the Baltic Air Exchange[1].

The large volume of passenger and freight transportation in Britain's air charter business has been in no small measure due to the shipping lines who, in order to avoid their vessels lying idle for long periods in foreign ports, have themselves utilized air facilities for the forwarding of urgently required spare parts, machinery, crews, etc. Today the economic recession of the last eighteen months is having a very uncomfortable influence on the merchant navy, with the result that many shipping companies are turning from air freight and personnel transport back to the sea routes. In addition travel agency bookings for air transportation are showing a sharp decline.

In other words, air charter business in England, as indeed is the case in the rest of the world, is today not as good as it has been. The *British Independent Air Transport Association's* Annual Report for the period 1956/57 showed a drop of 33 percent in freight ton-miles performed, and the 1957/58 figures showed that this loss was not fully recovered in the latter period.

As the position has deteriorated even further since the publication of these reports it is not surprising that attempts are now being made to apportion the blame. A recent article appearing in the Hamburg newspaper "Die Welt" holds the air freight exchange to be responsible[2]:

". . . for this development the independent air transport companies must themselves accept a large part of the blame. The air freight exchange, which is closely associated with the Baltic Exchange in London, continues to be decidedly unpopular. The shipper has no means of arriving at firm calculations which he should be able to rely on, particularly in times of recession. Thus, much freight which would have appeared to be predestined for air transportation, is being transferred to the sea routes . . ."

Criticism is always welcome, but in this case it appears to be very wide of the mark, and some clarification is called for. The Airbrokers Association in London is in no way a closed shop of independent air transport companies. Amongst the 40 British and 43 non-British carriers associated in this air freight exchange the following companies are listed: Air France, Air-India International, BOAC, BEA, Canadian Pacific Airlines, Lufthansa, PAA, Sabena, Swissair, etc.

But so far as any drop in turnover is concerned, The Airbrokers Association is responsible for neither the economic crisis, nor for certain inadequacies in the present air freight business which are discussed elsewhere in this issue.

In any case J. L. Logan, Secretary of the Airbrokers Association, sounds no pessimistic note in the words which he has penned for *Interavia:*

"As more attention is now being paid to the construction of freighter aircraft with higher payloads and cubic capacities, so will the volume and variety of cargo by air steadily increase.

"The recent decision of the British and other Governments to make their currencies more readily convertible should help to increase trading and the demand for air transport . . .

"Airbrokers on the Baltic Exchange, with their knowledge of the world of commodity and passenger movement, backed by the reputation for integrity built up and jealously guarded over two centuries, stand ready, as ever, to serve charterers and carriers throughout the world."

[1] "From Coffee House to Air Freight Exchange," January 1949, p. 14 etc.

[2] "Die Welt" December 16th, 1958: "Luftreeder auf neuem Kurs" by Rolf Görtz.

A Hunting-Clan Air Transport Douglas DC-6A at Nairobi Airport, Kenya.

Britain's Independent Air Transport Companies

In mid-1958 the total fleet strength of the 18 independent carriers forming the British Independent Air Transport Association (BIATA) stood at 74 four-engined and 134 twin-engined transports. On order for future delivery were 11 more aircraft, including 3 Bristol *Britannia 300s*, 5 Vickers *Viscount 800s* and 2 DC-6A/Bs.

A strong tendency towards a grouping of these companies is unmistakably emerging. For example British Aviation Services Ltd., a company controlled by the P & O shipping line, is the amalgamation of some 11 independent companies of which the most important is Silver City Airways, now famous for its cross-channel car ferry services.

The youngest of these working groups, formed in 1958 by the association of Airwork Ltd., Air Charter Ltd. and Transair Ltd., has an available fleet of over 45 aircraft.

Particulars of some of the most important of these independent carriers are listed below:

Air Charter Ltd. (formed 1947), 21, Wigmore Street, London and Southend Airport, Essex. Managing Director: F. A. Laker.
- Fleet (mid-1958): 1 Bristol *Britannia*, 3 DC-4s, 6 Avro *Tudors*, 9 Bristol 170s.
- Scheduled car ferry services from Southend to Calais, Ostend and Rotterdam; charter trooping services for the Air Ministry; passenger charter service Hanover-Berlin.

Airwork Ltd. (founded 1926), Airwork House, 35, Piccadilly, London, W.1. President: T. L. E. B. Guinness. Stock holding: Whitehall Securities Corp. Ltd.; Furness, Withy & Co. Ltd.; Blue Star Line Ltd.
- Fleet: 2 Vickers *Viscount 700s*, 4 *Hermes*, 5 Vickers *Vikings*; on order — 2 Vickers *Viscount 800s*.
- Scheduled services to Kenya, East, Central and West Africa; *Safari* services are operated in association with Transair and Hunting-Clan. Special charter work in Africa and trooping services to the Far East.

British Aviation Services Ltd. (comprising 11 companies, the most important of which is Silver City Airways), Silver City House, 62, Brompton Road, London S.W.3. Majority shareholding by P & O; Chairman: Eoin C. Mekie; General Manager: Air Vice Marshal S. D. Macdonald.
- Fleet: 21 Bristol 170s, 12 DC-3s, 5 *Hermes*, 3 others.
- Silver City Airways car ferry services to France and Belgium: from Lydd (Ferryfield) to Le Touquet, Calais, Ostend and from Southampton to Cherbourg and Deauville. In the financial year 1957/58 approx. 50,000 cars, 4,800 motorcycles, 154,000 passengers and . . . one submarine were ferried.

Eagle Airways of Britain Ltd. (IATA member, founded 1953), Marble Arch House Air Terminal, 40, Edgware Road, London W.2. Chairman and Managing Director: Harold Bamberg.
- Fleet: 15 Vickers *Vikings*, 2 Vickers *Viscounts*, 2 DC-6A/Bs.
- Operating services from the United Kingdom to Austria, Belgium, Denmark, Italy, Norway, Switzerland, West Germany, and from Bermuda to New York. 1957 — 631,000 ton-miles performed.

Hunting-Clan Air Transport Ltd. (founded 1946, and taken over in 1953 by Clan Line Steamers and the Hunting Group), London Airport, Middlesex. Chairman: P. L. Hunting; Managing Director: M. H. Curtis.
- Fleet: 6 Vickers *Viscounts*, 7 Vickers *Vikings*, 2 DC-6As, 3 DC-3s; on order— 2 Bristol *Britannias*.
- *Safari* services in conjunction with Airwork from London to Gibraltar, Nairobi and Salisbury, and all-freight services *(Africargo)* from the U.K. to East, Central and South Africa.

Skyways Ltd., 7, Berkeley Street, London W.1. Chairman: Sir Wavell Wakefield; Managing Director: E. Tylands.
- Fleet: 6 *Hermes*, 14 *Yorks*, 4 DC-3s.
- Scheduled services from London–Malta–Cyprus; tourist traffic and animal transport U.K.–France.

Transair Ltd. (see Airwork Ltd.), Gatwick Airport, Surrey. Chairman and Managing Director: G. H. Freeman.
- Fleet: 3 Vickers *Viscounts*, 10 DC-3s.
- Scheduled mail and newspaper services to Germany, France and the Channel Islands.

Air Freight

Origins and Development

The story of air cargo in the United States goes back to September 1927, as recorded in an article on air express published in the November 1955 issue of *Interavia*. As was also the case with passenger services, its early development was greatly influenced by the public interest aroused through Charles Lindbergh's crossing of the Atlantic in May of that year, which constituted a milestone in American air transport.

However it was not until 1933 that more suitable aircraft for the transport of cargo—which in those days was still limited to items of low weight and small bulk known as air express[1]—made their appearance. At the time when the first modern commercial aircraft—Boeing 247 and Douglas DC-2—were beginning to appear, a Curtiss *Condor* biplane with two 700 h.p. Wright *Cyclone* engines had three ventral holds with a total volume of 120 cu.ft. for small packages, and its cabin had accommodation for fifteen passengers. Its cruising speed was 170 m.p.h.

Despite the very high rates charged for air express at that time—eighteen times higher than the rates for the fastest surface means of transport—no fewer than 17,000 express packages were carried by the new services during their first year of operation.

Such were the beginnings of air cargo transport in the United States.

The development of air freight was greatly accelerated by World War II, which acted as a forcing house for commercial aviation. During the war the military Air Transport Command operated a virtually global network of services and employed a vast armada of Curtiss C-46 *Commandos*, Douglas *Dakotas* and *Skymasters* to carry not only troops but also ammunition and supplies of all kinds—including cargoes of strawberries for the troops stationed on the Atlantic island of Ascension—to the most distant theatres of operations. At the end of the war these services released a large body of veteran pilots who immediately set about looking for a paying job and hurled themselves on the war surplus aircraft which they employed to carry out similar missions in the domestic market. Some contributed their technical experience, others the dollars saved during their military service, but all were imbued with unshakable confidence in the future and all were determined to launch their own air cargo services. Moreover it was difficult to resist the temptation when the Reconstruction Finance Corporation rented veterans a *Dakota* for $4,000 a year, a sum which incidentally could be deducted from the purchase price of between $20,000 and $35,000 for an aircraft which Douglas had sold for $115,000 before the war. By 1946 there were a good hundred cargo companies in the United States.

But the inexorable law of natural selection was soon to make itself felt in this field like a real law of the jungle. Its operation too was greatly

[1] In American terminology *air cargo* is used to designate all items carried with the exception of passengers, namely mail, air express and heavy freight; *air express* means packages with an average weight of between 6 and 9 lb.; and *air freight* applies solely to larger and heavier consignments which are carried at substantially lower rates and lower speeds than air express.

Freight sheds belonging to Flying Tiger Line at the Lockheed Air Terminal, Burbank, California.

in the United States

assisted by the activities of the older scheduled companies who obviously did not look on this competition with a friendly eye. With their powerful commercial organization and their ability to call on several sources of revenue—among which passengers have always been far and away the most paying—they were in a much more favourable position to undertake air freight operations on their higher-frequency scheduled services. The established airlines could carry freight as a supplement to their passengers and did not have the same problems as the cargo operators in filling their available capacity, nor did they have to worry about the vital question of return freight. The result of this rivalry, which has never disappeared, is expressed eloquently by a single figure: today there are just four companies which are officially certificated for the scheduled transport of air freight within the United States.

The present situation

These four companies, in the order of their establishment, are as follows:

1. *The Flying Tiger Line,* the oldest and the most active of the four. It was founded in June 1945 under the name of National Skyway Freight Corporation with the original object of operating freight services on a contractual basis. Its first services began shortly afterwards on transcontinental routes via some of the bigger midwest centres. However, contractual operations did not prove to be a paying proposition, and in 1946 the company applied to the Civil Aeronautics Board for authorization to run regular services on certain transcontinental routes, generally in parallel to those of the mixed companies.[2] This authorization was granted, giving the company the status of a common carrier.

Flying Tiger has its head office at Burbank, California, at Lockheed's Air Terminal. Its fleet, recently modernized, today includes fourteen Lockheed L-1049H *Super Constellations* and two Curtiss C-46s.

2. *Slick Airways* is almost as old as Flying Tiger Line, since it was founded in January 1946. Named after its founder E. F. Slick, the company also began operations on a contractual basis and has undergone very much the same development as Flying Tiger. It received authorization for scheduled cargo services in August 1947. Its routes are also parallel to those of the mixed companies' transcontinental services and connect New York with California, via Chicago and Kansas City on the one hand and via Texas (Dallas, where it has its head offices, Fort Worth, San Antonio and Houston) on the other. It has also been certificated by CAB to operate non-scheduled services to 28 smaller centres where agricultural production requires at any rate seasonal services. Like its predecessor, Slick has organized a supplies, overhaul and engine maintenance service at San Antonio international airport, which has enabled it to make good to a certain extent for its operating losses on scheduled cargo services. The operating loss for 1957 was more than $3,000,000 and forced the company to suspend its scheduled services from February 22nd, 1958. The original plan was to resume these services on January 1st, 1959, by which date it expected to receive the subsidy which it had requested from CAB. This subsidy however was refused at the end of 1958. The company is therefore in a somewhat precarious position, despite the efforts of its Chairman Delos W. Rentzel whose organizing abilities were recognized when he was appointed head of the Civil Aeronautics Administration.

Slick's fleet, according to recent information, is now composed solely of older aircraft, namely three DC-4s and five C-46s. A few years ago it had bought eight Douglas DC-6As, but these have since been sold again.

3. *Riddle Airlines* was founded about 1946 by John P. Riddle and specialized in the transport of high quality textiles, such as lace and embroidered goods, from the New York mills for finishing in Puerto Rico, where skilled labour is less expensive than in Federal territory. These cargoes pass via Miami, Florida, where the company, which received from CAB the status of scheduled air carrier in 1951, has its head offices. Return freight includes the same goods ready for the retail market, as well as various tropical products (including occasionally serpents and exotic fish).

The economic recession which began in the United States at the end of 1957 led the company to ask CAB for a subsidy, but this was also refused in December 1958. Riddle Airlines' fleet consists of twenty C-46s and ten DC-4s.

[2] i. e., companies operating scheduled passenger, mail and freight services.

C. Charles Gaudio, *General Manager of the Air Express Division, the air cargo division of the Railway Express Agency.*

On the first National Airlines jet flight from New York to Miami (on December 10th, 1958) 56 Air Express shipments were carried. Alfred L. Hammell (right), President of the Railway Express Agency, hands over a package of instruments to the pilot of the Boeing 707.

America's "Air Express" speeds up delivery service

Several articles in this issue emphasize the fact that freight operations continue to suffer from slow ground handling—collection of the goods from the consigner, transport to airports, delivery to the consignee.

However, a valuable service has been available for many years to the U.S. airlines to enable express consignments to be dealt with promptly; this is the Railway Express Agency, founded in 1839, which formed an air cargo division known as Air Express at the end of 1927.

The history of Air Express was dealt with in such detail in *Interavia* No. 11, 1955, p. 853, etc. that little remains to be added here.

Working together with 223 railroad companies, 11 shipping concerns and 35 airlines, the Railway Express Agency operates a pickup and delivery service in 6,600 cities in the United States; for this purpose it maintains 13,500 motor vehicles and also makes use of America's trucking services.

Helicopters, delivery cars in touch with the company's offices by radio, electronic coordination of the transport network . . . the Air Express Division has thought of everything to cut down wasted time in its door-to-door express service. In 1928, the first full operating year of Air Express, a total of 17,006 shipments were dispatched, and in 1957 more than 5,000,000.

	No. of shipments	Short ton-miles	Route network (miles)	Operational revenue
1928	17,006	—	7,748	130,774
1957	5,064,301	46,407,191	143,000	36,857,350
1958*	5,466,840	50,541,713	132,541	41,693,332

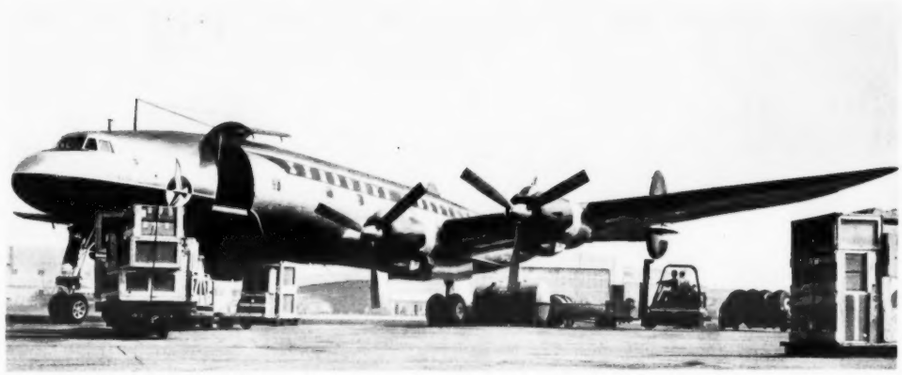
* Estimate

Air Freight

Seaboard & Western Airlines Inc.,

80, Broad Street, New York 4, N.Y.

Seaboard & Western is the largest overseas freight airline in the USA and belongs to the International Air Transport Association; it inaugurated services to West Europe and the Middle East in May 1947. Today the company has a fleet of nine Lockheed *Super Constellations*, four Douglas DC-4s and one C-46.—North Atlantic service New York–Gander–Shannon, and from Shannon three routes to West Europe: 1. Paris–Basle–Geneva–Zurich; 2. Glasgow–London–Amsterdam–Hamburg; 3. London–Dusseldorf–Frankfurt–Stuttgart–Munich. 1,050 employees. The airline was founded by the brothers Raymond A. Norden (President) and Arthur V. Norden (Executive Vice President).



4. *AAXICO* is the youngest of the four since it did not begin operations until November 1956. Its name is an abbreviation of American Air Export and Import Co., and it also has its head offices at Miami. Its air activities consist primarily in non-scheduled services, operated with a fleet of 22 C-46s. It too has an organization for the sale of aircraft and the maintenance and overhaul of flying equipment.

What is the present financial situation of the American all-cargo carriers? Considered as a whole it is anything but brilliant. The operating results for this group of companies, expressed in thousands of dollars, for the last three business years (the figures for 1958 are not yet known) are as follows:

	1955	*1956*	*1957*
Operating revenues	27,035	52,860	87,668
Expenditure	26,343	53,879	90,311
Profit or loss	+ 692	— 1,019	— 2,643

Including non-operating revenue, which came principally from the sale of aircraft, the return on capital dropped from 9.4 percent in 1955 to 7 percent in 1956 and to 0.5 percent in 1957.

It is therefore not surprising that the operators should look around for auxiliary activities or seek subsidies to compensate for the losses they sustain on some of their scheduled freight operations. To a certain extent these losses can be made good by the freight contracts signed with the military authorities, but these are only temporary resources and are in addition becoming rarer, as the present trend is for the military services to operate the maximum possible services with their own equipment.

This crisis, which began more than a year ago, is due not only to the recession but also to the vastly more favourable operating conditions for the mixed companies which run on competitive routes with aircraft that are more modern and hence more economical per ton-mile offered, and for whom the transport of freight is a minor operation (3.5 percent of the total revenue of the domestic trunk lines in 1957). The following table gives the ton-miles performed by these two categories of carriers on scheduled domestic services in 1957, with comparative figures for 1957 in brackets (only the four largest operators have been chosen to represent the trunk lines):

All-cargo lines		**Trunk lines**	
	(in thousands of ton-miles)		
AAXICO	2,300	American	82,500 (71,400)
Riddle	21,300 (21,200)	U.A.L.	56,600 (50,100)
Slick	49,800 (63,600)	T.W.A.	25,200 (23,700)
Flying Tiger	83,000 (67,100)	E.A.L.	15,600 (14,700)

As will be seen, competition is keen.

Taking the whole of the U.S. airline industry (all carriers, scheduled and non-scheduled), the domestic services produced a total of 599 million ton-miles in 1957 of air express and freight. This of course is a very modest figure compared with that for road traffic, which exceeds 200,000,000,000 ton-miles a year, or railway traffic amounting to more than 600,000,000,000 ton-miles, or more than a thousand times the volume of air traffic.

Are the freight rates charged by the all-cargo carriers so high that they discourage customers from using this high-speed means of transport? Compared with the rates in force for rail or road transport, air freight is still an expensive business. Three years ago the railroad companies were charging an average of 10 cents per ton-mile for express goods, compared with 39 cents for air express. But an examination of the comparative development of rates during the past ten years reveals that air cargo rates have remained practically unchanged, despite the fact that the cost of living has constantly risen. In a study entitled "Vision in Air Cargo" published by the University of Washington College of Business Administration in 1957, Stanley H. Brewer took 100 as index for rates in 1947 and found that in 1955 the corresponding figures were as follows:

Rail 127.3; Road 134.7; Air freight 95.8; Air express 105.7.

According to the same author the average rates for air freight (in cents per ton-mile for the trunk airlines) moved as follows during this period:

	1946	*1947*	*1948*	*1949*	*1950*	*1951*	*1952*	*1953*	*1954*	*1955*
Air freight	28.3	23.7	19.6	19.4	19.2	20.9	21.7	22.2	20.8	22.7
Air express	38.8	36.9	33.4	32.7	34.3	36.5	39.2	37.5	37.1	39.0

Since then the railroads have obtained an average increase of 20 percent in their rates, while charges for air freight have remained more or less stationary. Surface transport has thus been more sensitive to the general rise in prices than air transport, which means that the margin between the rates charged by the two means of transport is diminishing. Making allowance for the difference in the distance between two points by air and by rail (air routes are from 18 to 32 percent shorter than corresponding rail routes) the air rates for small loads will be comparable to those of the surface carriers within a few years.

In 1958 American Airlines introduced the Paul Bunyan Box, an aluminum container for freight transport manufactured by Grumman Aircraft Engineering Corp. Length 84 inches, height 42 inches, width 62 inches. In 1957 American Airlines recorded about 86,000,000 freight ton-miles—more than all the other U. S. domestic freight carriers.

Million ton-miles

Could not this goal be reached more rapidly if the air carriers made a concentrated effort towards systematic reductions in cargo rates? Present business conditions make this appear unlikely. Moreover ever since there have been cargo aircraft, the operator has found himself faced with the following dilemma: how far must rates fall in order to attract customers, but how far may they fall if profitable operation is to be achieved? In other words, they find themselves in a vicious circle; operating costs affect the rates charged, but rates affect the volume of traffic, which in turn reacts on operating costs.

Vitality and versatility

Whatever may be the present situation of the air freight business in the United States, its development has been impressive.

Again taking the figure of 100 as index for 1948, we find ten years later that this had risen to 376 for the total passenger-miles performed, but to as much as 637 for the total ton-miles performed by the scheduled all-cargo carriers. What better evidence could there be of the vitality of this young industry?

Its versatility is best expressed by the famous quip "we accept everything except giraffes". In fact American cargo aircraft have carried just about everything up to and including loads of coal during the 1948 Berlin airlift. The following are a few examples of more or less unusual cargoes.

As early as 1929 a chicken farmer in Texas asked PAA to carry eggs for hatching in Central America. Twelve dozen were sent to Guatamala in this way, with only two of them being broken en route. The idea caught on, but as freshly hatched chicks weigh only half as much as eggs and can comfortably live for their first 72 hours without food, Pan American soon began carrying young chicks almost daily to the Caribbean and Central and South America where young poultry is the *pièce de résistance* at almost every meal.

In 1947 United Air Lines, soon followed by Eastern Air Lines, began transporting complete DC-3 loads of swarms of bees from California agricultural centres to the Middle West. This rapid means of transport has the advantage of greatly reducing the loss of protein.

In 1949 the American Safety Razor Corp. of Brooklyn mobilized twenty cargo aircraft to carry 25,000,000 blades to its 150,000 retailers.

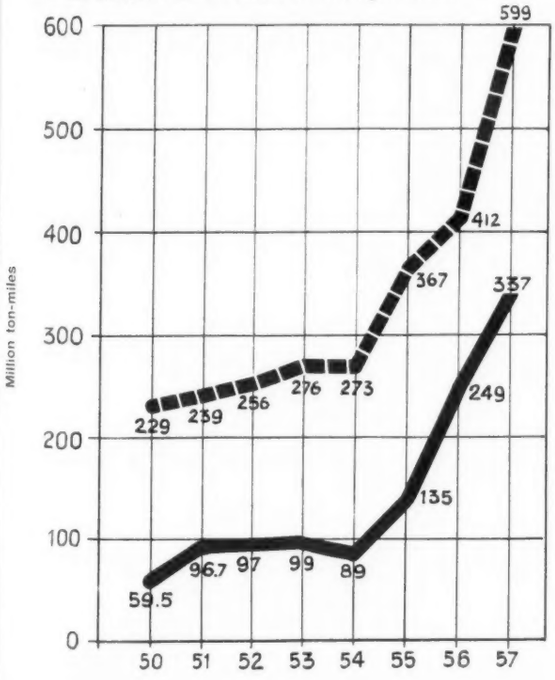
In 1950 Northwest Airlines sent a load of frozen milk to Shemya in the Aleutians, where there are no cows.

In 1951 a shaft weighing ten tons was carried by a Slick Airways DC-6A from Philadelphia to the Aluminum Co. of America in Los Angeles, a distance of 3,000 miles. The delivery, which would have taken eleven days by rail, was accomplished in twelve hours.

A Hawaiian air carrier was asked some three years ago to transport three tons of special mud to fill in well holes.

For several years past Slick Airways has been transporting women's garments from the factories in Texas to the stores in the major Atlantic seaboard cities, thus greatly reducing the time required for their transport—

Easily the biggest percentage of the total American air freight revenue is collected by the scheduled mixed service airlines (passengers and freight). The development between 1950 and 1957 in ton-miles is shown. The broken line represents total U.S. freight volume, and the unbroken line the results of the freight airlines.



PAA has discovered that baby chicks are more economical to transport than eggs as they weigh only half as much and can live comfortably for their first 72 hours without food.

an important consideration for new models. The garments are packed on hangers in plastic bags which are then suspended in the aircraft. This reduces packing costs and makes it unneccessary to press the garments on their arrival. On the return flights to Texas the aircraft carry fabric made in New York.

More conventional cargoes are mentioned below to complete the picture.

Slick and Flying Tiger carry fresh cut flowers from California as far as the major centres in the Atlantic region, which has enabled horticulturalists in the Los Angeles area to double their sales. In the days of surface transport fresh flowers could be carried no further than the Middle West.

Perishable goods, such as fruit from the orchards of California or Florida, lettuces, shell fish and other fish carried by air reach an annual volume of 200,000 tons, or 25 percent of all the sea food supplied to the American inland market.

Looking ahead

Air freight in the United States is still more or less in its early days. It has not yet reached the stage of mass transport, the dream of its promoters. There has been no lack of forecasts of future freight development since the end of the war, one of the best known of which was published in 1944 by the late Edward P. Warner in the magazine "Air Transport". Basing his estimates on the figures for railway express, the eminent specialist in the problems of civil aviation forecast the following development of air traffic depending on the rates applied per ton-mile:

at 20 cents:	60,000,000 ton-miles
at 15 cents:	145,000,000 ton-miles
at 10 cents:	300,000,000 ton-miles
at 6 cents:	2,000,000,000 ton-miles

In view of the fact that the total freight traffic carried in 1957 amounted to nearly 600,000,000 ton-miles, at average rates of above 20 cents per ton-mile, Edward P. Warner's forecasts cannot be described as exaggerated.

Another attempt at predicting future development was the study published in 1950 by the Port of New York Authority, who estimated that traffic in 1960 would be 555,900,000 ton-miles at a rate of 14 to 16 cents per ton-mile. This figure has already been exceeded.

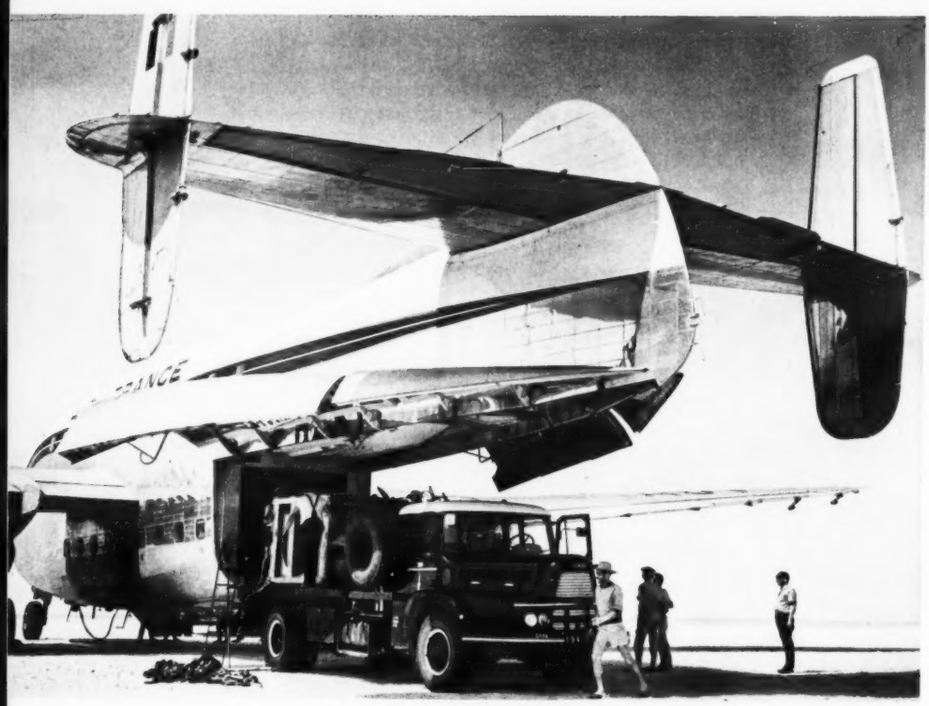
It is therefore quite legitimate to conclude that the future of freight traffic in the United States is full of promise. Although by its very nature the aircraft is an expensive means of transport, since the power used must both support and move the load, it must not be forgotten that air freight has so far only nibbled at its vast potential market and is still suffering from a number of teething troubles. The aircraft used are still not fully adapted to the tasks they are required to perform, customers and the general public still require educating to accept air freight, and there are handicaps in ground handling which is frequently too slow to cope with the growing capacity of the aircraft.

However the history of all means of transport reveals that every new instrument introduced takes several years to establish itself, during which time it generally attracts only existing traffic which cannot be handled by the older means of transport.

After this "running in" period—the stage at which air freight in the United States still appears to be operating—the newcomer begins to create its own new traffic, whereupon the volume of its activities really begins to expand. Such has been the story of rail transport in the New World compared with the earlier waterways traffic, and later of road transport compared with rail.

In view of the fact that the aircraft is the only vehicle, with the possible exception of a few tankers, which has not yet reached its maximum limit in size and transport capacity, it can be confidently expected to have a successful future in front of it.

The Aircraft for Freight Operations



The preceding articles have shown that air freight is regarded by the scheduled airlines on the whole as a "stop-gap" and that the pure cargo operators—with a few exceptions—are not doing too well these days. Why?

Leaving aside for the moment all the purely organizational questions, let us turn our attention to the technical prerequisites for the satisfactory development of the air freight business, namely the aircraft. All the experts agree that firstly a high payload capacity plus highest possible cruising speed—in other words a high transport capacity—are the minimum basic requirements in cargo aircraft and secondly that purchase, operating and maintenance costs also play a major role. This, of course, has always been the case, but the figures demanded for payload, range and cruising speed have advanced by leaps and bounds during recent years. As the present need is to cut off another large slice from the overall transport volume "cake" for the benefit of civil air freight, operating costs per ton-mile must be drastically reduced.

Canadair CL-44D (top), a small number of which have so far been ordered by the Royal Canadian Air Force (RCAF designation CC-106). This transport is powered by Rolls-Royce Tynes *and is derived from the CL-28* Argus *naval patrol aircraft and the Bristol* Britannia. *The CL-44D is also offered in a civil version for freight and passenger transport.*

The Breguet 763 Deux Ponts *transport (centre) is operated by Air France for mixed passenger and freight services.*

Finally, the picture on the right shows Holland's F.27 Friendship, *whose cargo version bears the designation* Freightship.

Developed as a troop transport and military cargo aircraft, the twin-engine Nord 2501 Noratlas *is built in several versions and in large numbers. It has, for example, been selected for the Air Force transport squadrons in the Federal German Republic, where it is being produced under licence.*

The Beverley *freighter, produced by Britains Blackburn & General Aircraft, is in service with RAF Transport Command. A later development is the B.107A, shown in the diagram, for civil and military freight duties.*

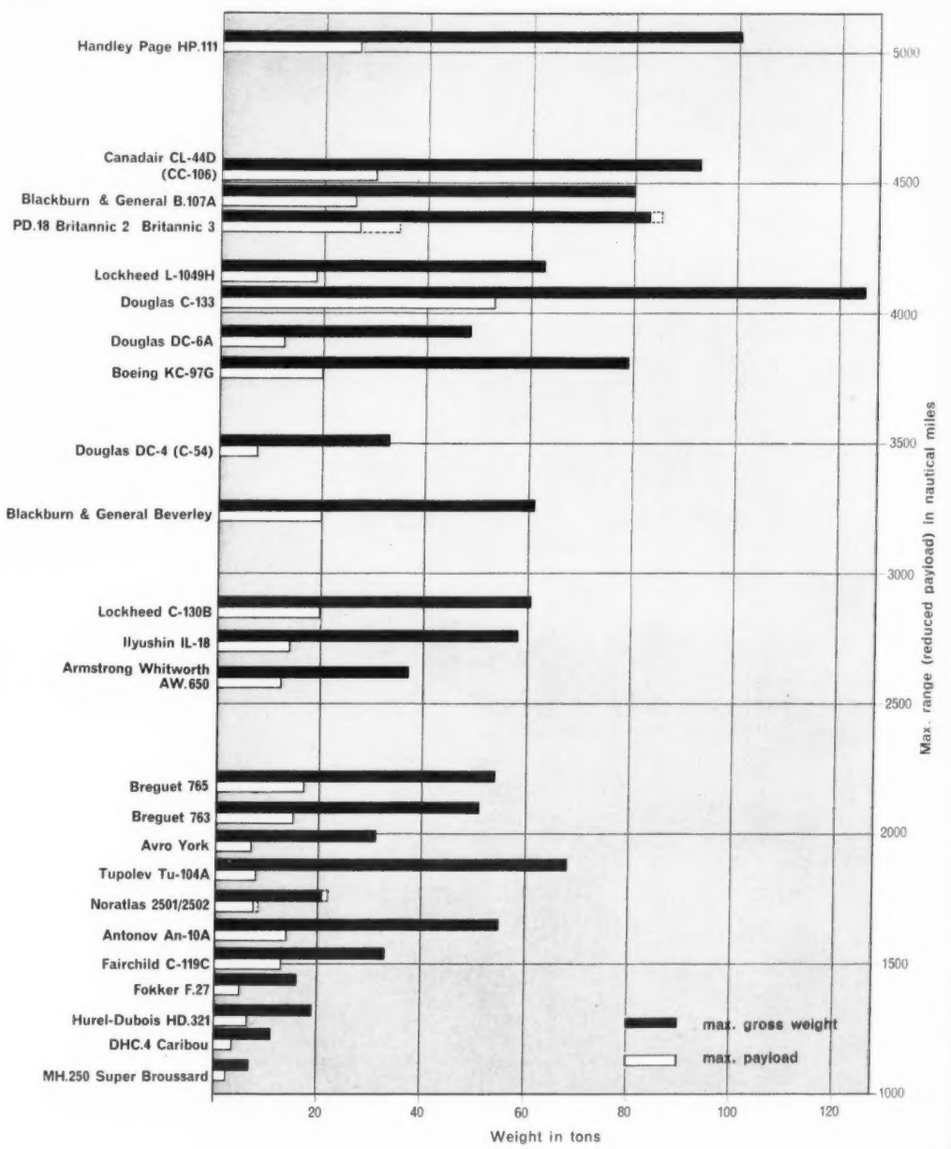
Military transport aircraft have proved that this can be done.

Also of vital importance is the quality of the technical installations designed to ensure rapid loading and unloading of bulky or heavy goods. So long as freight can be loaded only through side doors in the aircraft, as is at present the case, there can be no question of rational operation. What is indisputably required is direct access to the length of the freight hold, which is at present provided only in a few specialized car ferry aircraft (e.g., the Bristol *Wayfarer)* and in the heavy military transports.

To put it quite plainly, aircraft suitable for air cargo operations on a large scale today are available only to the air forces of a few leading Powers, and at best only prototypes are in sight for the civil operator. But it is only with really modern equipment that freight rates can be reduced and hence the volume of cargo carried substantially increased.

A valuable pointer here could be the giant Douglas C-133 *Cargomaster* military transport, which with its gross weight of 255,000 to 282,000 lb. can carry a maximum payload of 117,900 lb., has a useful volume of more than 13,000 cu.ft. and can still carry up to 55,000 lb. over a range of nearly 3,500 nautical miles. In a lower weight class the Armstrong Whitworth AW.650 *Argosy* civil freighter (see following article) and the Nord-Aviation *Noratlas* would seem to meet the main technical and economic requirements mentioned above. It may also be that the Breguet 765 *Sahara,* derived from the well-known *Deux Ponts,* and civil versions of the Lockheed C-130 *Hercules* will be introduced

The diagram below shows the comparative maximum payloads and gross weights of some of the aircraft types suitable for cargo operations. The aircraft are arranged in order of increasing maximum range.



Open freight hatch in the USAF Lockheed C-130 Hercules *transport (four Allison turbines), which is offered in two versions, the C-130A and C-130B. Several airlines are also studying its possible use on civil freight services.*

into air freight service. All these aircraft have at least a rear-loading door, and two of them are also equipped with nose doors.

*

It therefore seems probable that some of today's military transports will be found among the next generation of civil freight aircraft, gradually replacing the equipment now in service. The present survey of existing and future cargo aircraft therefore draws no distinction between military and civil types. The diagram compares the maximum permissible payloads (over reduced ranges) and gross weights of all aircraft suitable for air cargo transport, and is arranged solely in order of increasing range; the accompanying pictures illustrate the most important newer freight aircraft.

At the lower end of the range and size scale are Holland's *Freightship*, derived from the

The Lockheed L-1049H Super Constellation, *a version of the L-1049G convertible for either cargo or passenger use, is powered by four Wright R-3350-EA.3 piston engines and has a reinforced cabin floor to take concentrated loads. It can be quickly converted from cargo aircraft to passenger transport.*

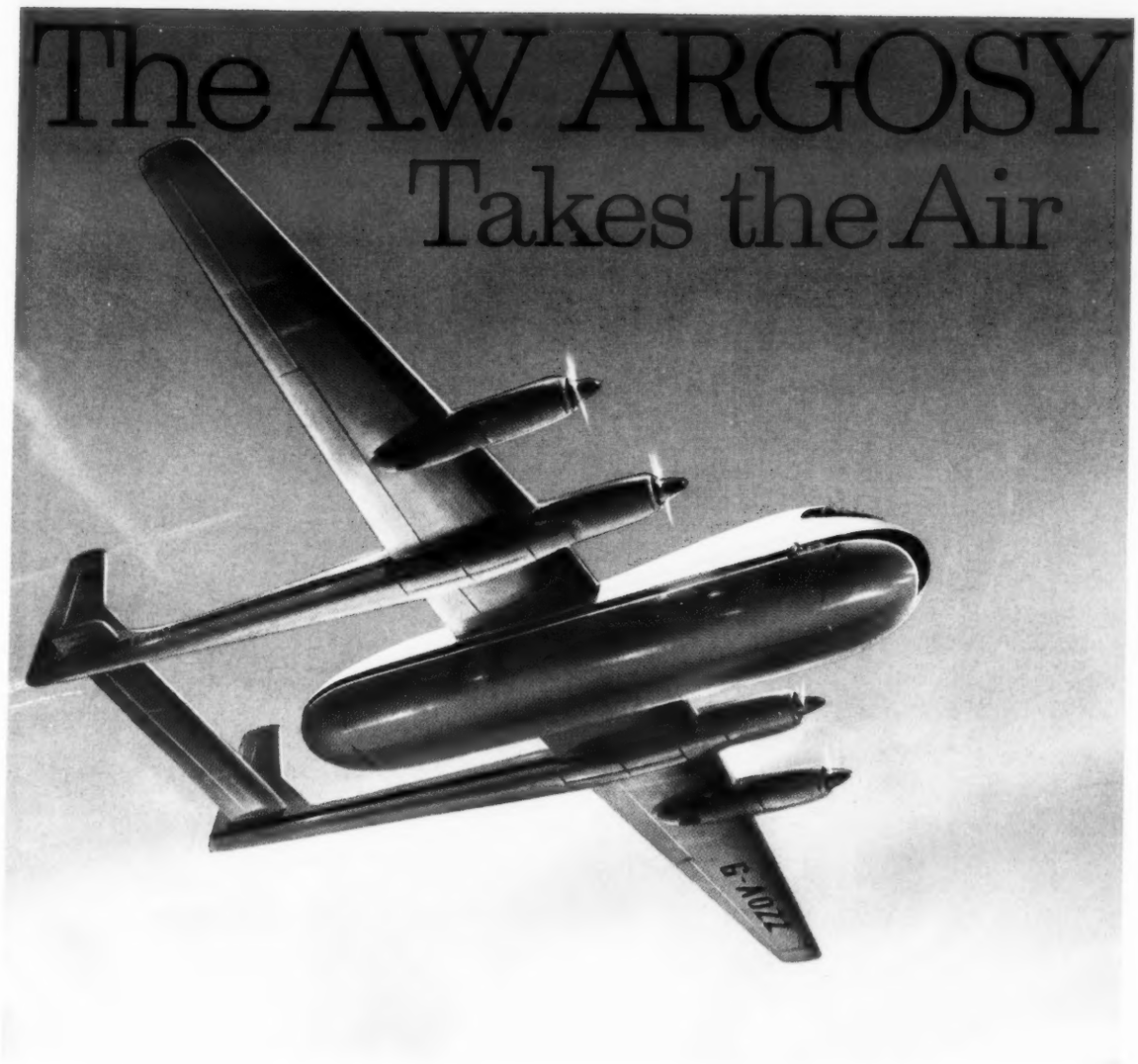
Douglas DC-6A Liftmaster, *a freight version of the well-known DC-6, is used not only for civil cargo services, but also as a military freighter (USAF type designation C-118, U.S. Navy designation R6D-1).*

Loading a Douglas C-133 Cargomaster *(four Pratt & Whitney T34 turboprops of 6,000 e.h.p. each). The C-133 is at present being built solely for military use, but is regarded as a pointer to future giant civil transports.*

Fokker F.27 *Friendship*, the DHC. 4 *Caribou* which has gone into production at The de Havilland Aircraft of Canada, and the *Super Broussard*, a twin-engine development of the Max Holste *Broussard* multi-purpose aircraft now in operation in large numbers. The middle portion of the scale is occupied by the older American freighters (Douglas DC-6A, Lockheed L-1049H and Boeing *Stratocruiser*), Britain's Bristol *Freighter* and France's Nord-Aviation *Noratlas*. Finally, come the Lockheed C-130 *Hercules* and the Breguet *Deux Ponts*, accompanied by the new Canadair CL-44D, Blackburn B.107A and Bristol *Britannic*, all three of which are still under development. At the very top is the Douglas C-133 *Cargomaster* super freighter.

Finally, there is already talk of jet-powered cargo aircraft, namely adaptations of the Boeing 707 and Douglas DC-8.

The A.W. ARGOSY Takes the Air



HAWKER SIDDELEY BREAKS PRODUCTION RECORDS WITH NEW AIR FREIGHTERCOACH, FROM "GO AHEAD" TO FIRST FLIGHT IN 28 MONTHS

The Armstrong Whitworth Argosy is the world's first pressurised turboprop freighter-coach. Never before in Britain has such a large and complex aircraft made its first flight so soon after the decision to go ahead —only 28 months. This is further proof of Hawker Siddeley's unrivalled reputation in the British aircraft industry, not only for high quality craftsmanship, but ability to meet and beat production schedules. The Argosy ushers in a new era of "flying without frills". It offers 300 m.p.h. economical air transport for freight and coach-class passengers. With its capacity for 13½ short tons, full-width doors and quick-loading system, it reduces turn-around time and freight rates to a minimum. The Argosy can be in service on the world's air routes by 1960.

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Baginton, Coventry, England / Member of Hawker Siddeley Aviation Division

THE ***Argosy*** ... BRINGS THE COST OF AIR FREIGHT DOWN TO EARTH

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The CL-44, the Royal Canadian Air Force's newest strategic transport aircraft, is now in full scale production at Canadair. The CL-44 is available in commercial cargo and passenger versions for delivery early in 1961.

Canadair invites enquiries: Contact our European representative: J. H. Davis, Princes House, 190 Piccadilly, London, W. 1, England.

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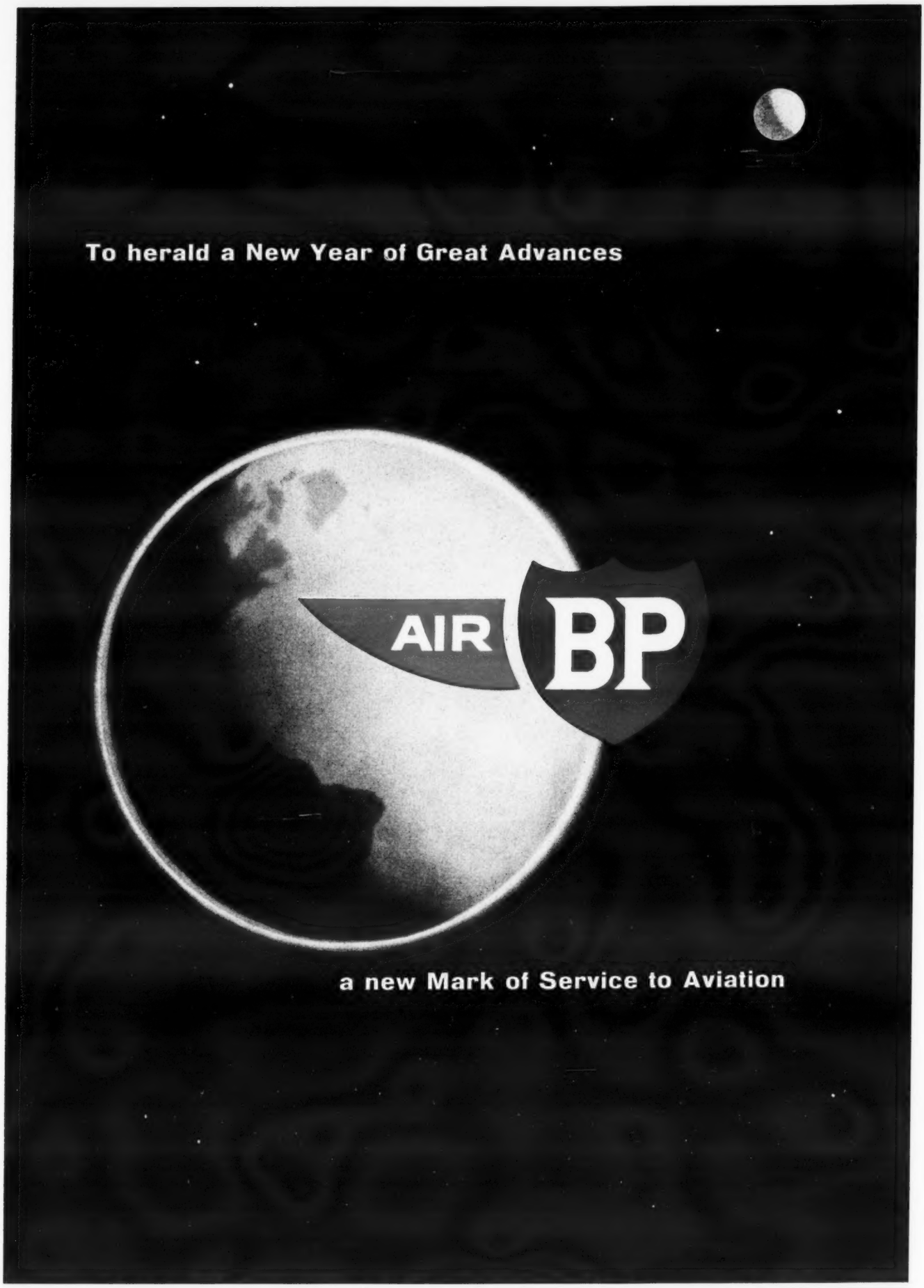

To herald a New Year of Great Advances
AIR BP
a new Mark of Service to Aviation

Argosy & Co.

The Armstrong Whitworth AW. 650 Argosy and its Variants

The first of ten AW.650 *Argosy* civil freight and passenger transports, now "on the stocks", made its maiden flight on January 8th this year. This aircraft, which is destined for basic flight testing, has at present neither passenger seats nor freight-loading equipment, but carries a set of water ballast containers, with the aid of which the performance and flying qualities of the new type are to be ascertained during take-off and in flight. In addition, two other transports due to be completed at the end of January and the end of February 1959 (there are no prototypes in the true sense of the word) will share with the first model the various tests laid down by the Air Registration Board; at the same time two complete airframes, outside the batch of ten, are being built for static and fatigue testing "to exhaustion". Finally, a vast demonstration tour is scheduled next summer for Works No. 4, which will be the first *Argosy* to be fully equipped and certificated.

This extensive and costly programme reveals the degree of importance which *Sir W. G. Armstrong Whitworth Aircraft Limited* (a member of the Hawker-Siddeley Group) attaches to the debut of its newest creation. The manufacturers are convinced that their *Argosy* can simultaneously solve a number of urgent transport tasks:

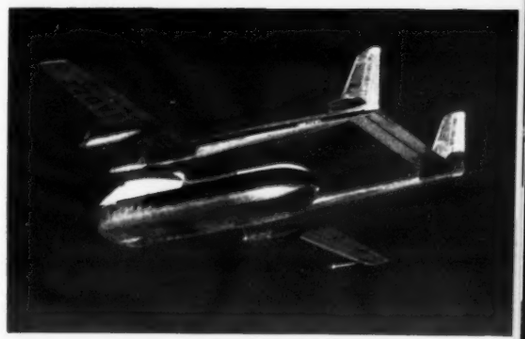
- Economical freight and mixed transport (passengers plus freight) on *medium* stages, thanks to its high payload capacity (28,000 lb.), long range (up to 2,400 nautical miles) and high cruising speed (versions AW.650 and AW.651).
- High-speed military transport (troops, vehicles, supplies) on *medium* stages (versions AW.660 and AW.661).
- Car ferry or tourist services on *short* stages, using a double-deck unpressurized fuselage (versions AW.670 and AW.671).

Full of confidence in the quality and hence in the ultimate sales appeal of this design, the Hawker-Siddeley Group is willing to put up to £10,000,000 into its purely private venture. *H. M. Woodhams,* Managing Director of Armstrong Whitworth, recently stated: "No money has been spared in preparing *Argosy* series production."

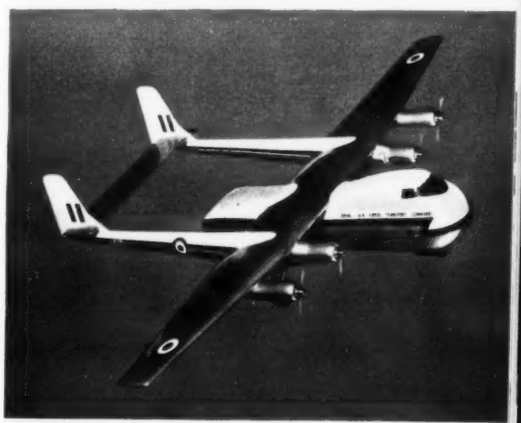
*

Although the first ten aircraft will all be of the *AW.650 medium-haul series,* with four Rolls-Royce *Dart 526 RDa.7/2* engines of 2,100 e. h. p. each, and single-deck pressurized cabin for freight and/or passengers, the project work for the other series is also practically completed. The manufacturers have these specifications ready for all potential customers —RAF Transport Command, car ferry operators, short-haul carriers—and guarantee early delivery dates. Initially *three* sister versions of the AW.650 are offered, all three with four *Dart RDa.7/2* turboprops, the same engines as the *Argosy*.

AW.660 version: military transport for medium stages, with "beaver-tail" fuselage in-



January 8th, 1959: first flight of the AW. 650 *Argosy*.



AW.660 military transport version with "beaver-tail" fuselage.

The first (G-AOZZ) of the ten AW.650 *Argosy* civil freight and passenger transports now under construction is destined for basic flight testing: maximum take-off weight is 82,000 lb.

Data for the AW.650 Argosy

Main dimensions:

Span	115 ft.
Length	86 ft. 9 in.
Height	27 ft.
Gross wing area	1,458 sq.ft.
Fuselage length	60 ft. 7 in.
Aspect ratio	9.07
Fuel capacity	3,300 Imp.gals

Hold layout:

Gross freight volume	3,680 cu.ft.
Gross freight floor area	426 sq.ft.
Overall length	46 ft. 8 in.
Width at floor level	10 ft.
Maximum width	11 ft. 8 in.
Minimum height	6 ft. 8 in.
Maximum height	8 ft. 9 in.
Hold floor level above the ground	4 ft.

Weights:

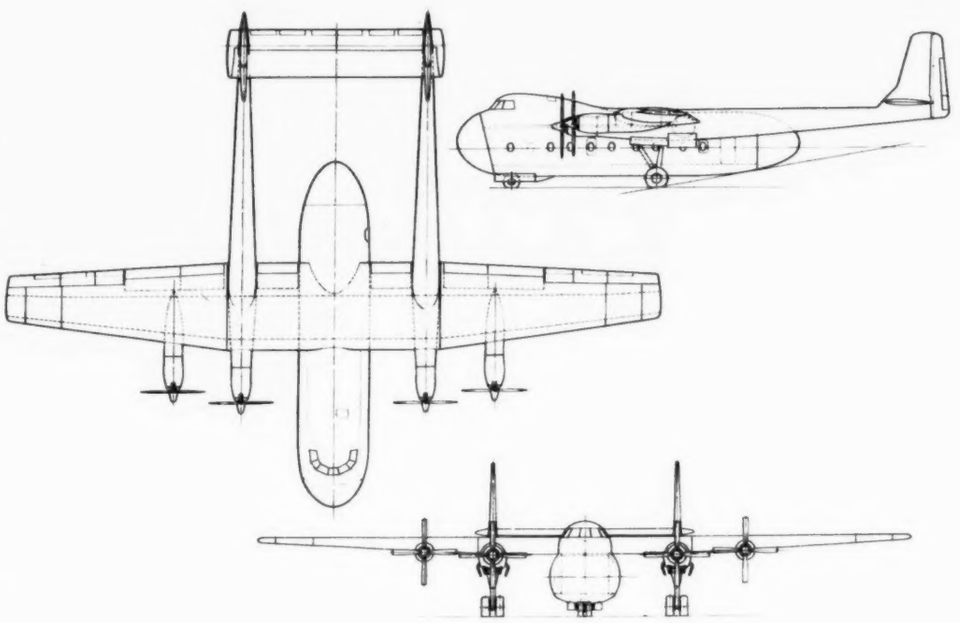
Maximum take-off weight	82,000 lb.
Maximum payload on short ranges	28,000 lb.

Estimated performance:

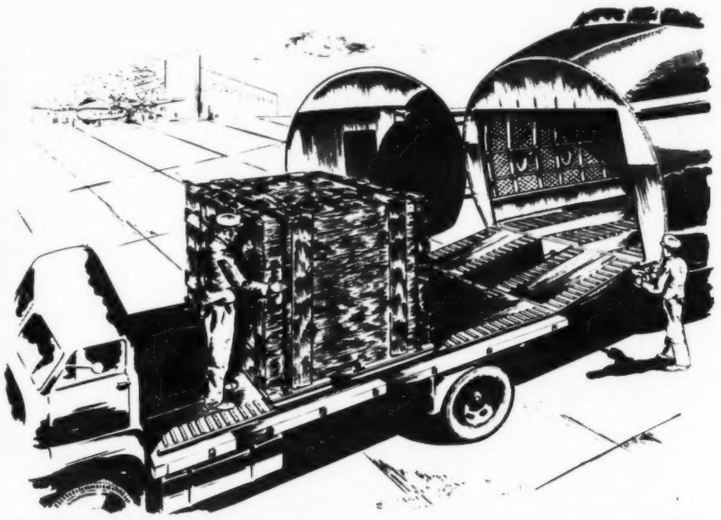
Take-off field length, full take-off weight, at sea level, ISA conditions	4,050 ft.
Mean cruising speed at 14,000 r.p.m.	296 m.p.h.
Maximum cruising altitude	25,000 ft.
Maximum range approx.	2,400 n.m.

Powerplant:

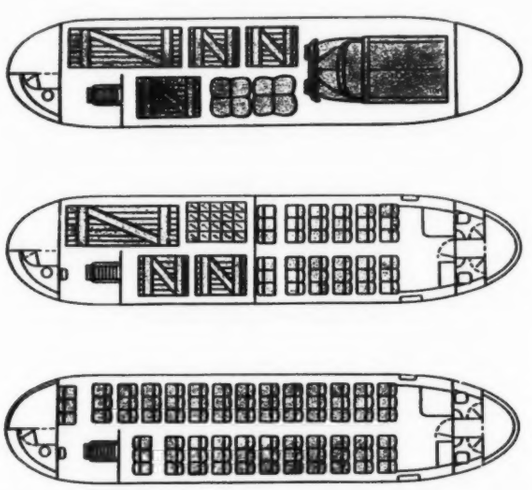
Four Rolls-Royce *Dart 526 RDa.7/2* propeller turbines	4×2,100 e.s.h.p.
Diameter of Rotol propellers	11 ft. 6 in.



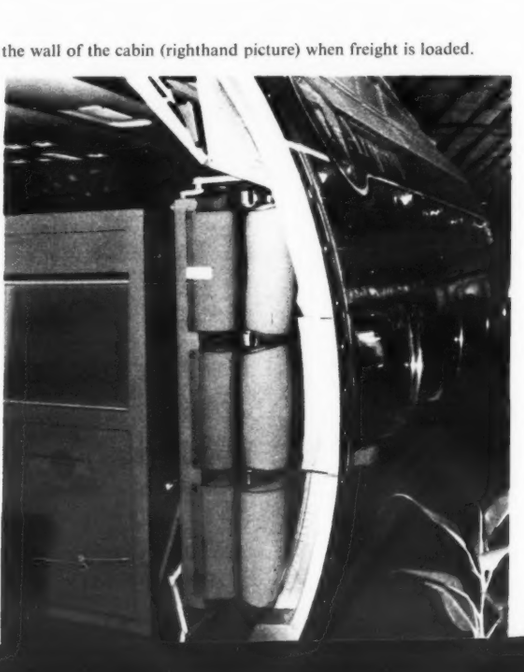
Loading heavy freight with the aid of a roller floor. When passenger seats are installed the rollers are reversed to make a flat floor.



Loading possibilities of the AW.650: top, the pure freighter with a gross freight floor area of 426 sq.ft.; centre, a mixed version for 36 passengers and freight; below, the passenger version with 75 seats.



Mockup of the *Argosy* fuselage with fixed seats (back row) and fold-up seats..., which can be folded against the wall of the cabin (righthand picture) when freight is loaded.



stead of the normal rounded fuselage. In this version the aft door of the tunnel-like freight compartment consists of a "lid" which is raised upwards, and a built-in loading ramp below; this model is also suitable for parachute load-dropping and in-flight refuelling. The makers have calculated that two transport squadrons equipped with this type (apparently 40 aircraft) could carry 1,300 troops and 75 tons of military equipment from Britain to the Middle East overnight.

AW.670 version: car ferry with broader, double-deck, non-pressurized fuselage, equipped to take six cars (in three pairs) on the lower deck, and 30 passengers on the upper.

AW.671 version: Airbus for short-haul services with similar fuselage to the AW.670. The lower deck can take up to 96 passengers in an eight-abreast seating layout, the upper deck 30. With a total of 126 seats direct operating costs over stages of around 200 miles will be under 2d per seat mile, an exceptionally low figure.

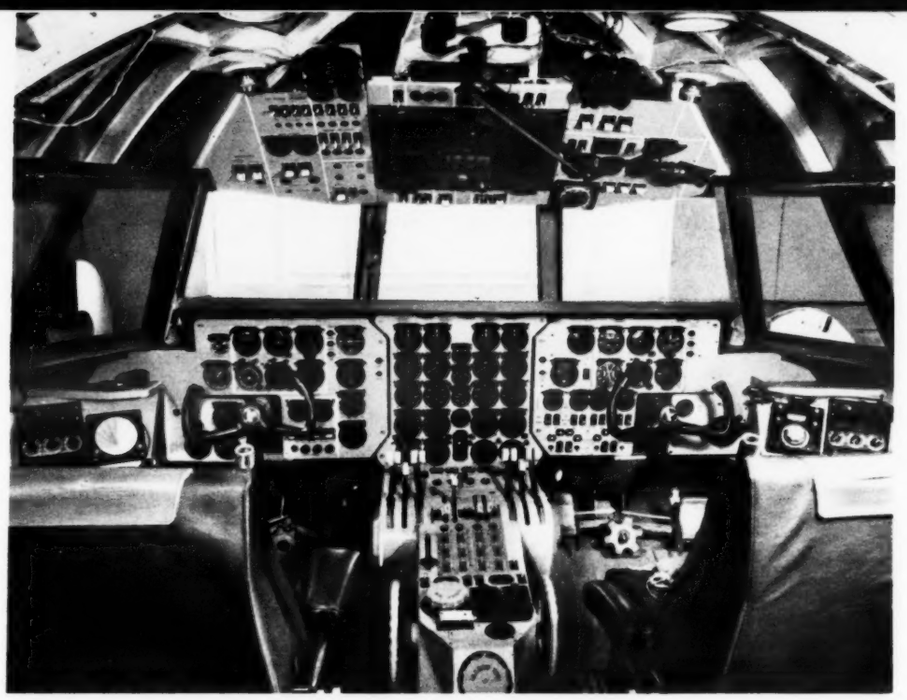
Eventually it is planned that the AW.650 and AW.660 medium-stage transports will be replaced by two *further versions,* in which the four Rolls-Royce *Dart RDa.7/2* turboprops will be replaced by two Rolls-Royce *Tyne RTy.1s,* each of almost twice the power (4,985 e. h. p.). Thanks to the considerably more favourable specific fuel consumption of the *Tyne,* which has a double axial compressor of very high compression ratio (13 : 1) instead of the *Dart's* radial compressor, these two versions promise further marked improvements in transport economy and range, in addition to simplified engine maintenance. These versions are:

AW.651: medium-stage transport for freight and/or passengers, like the AW.650 with pressurized fuselage.

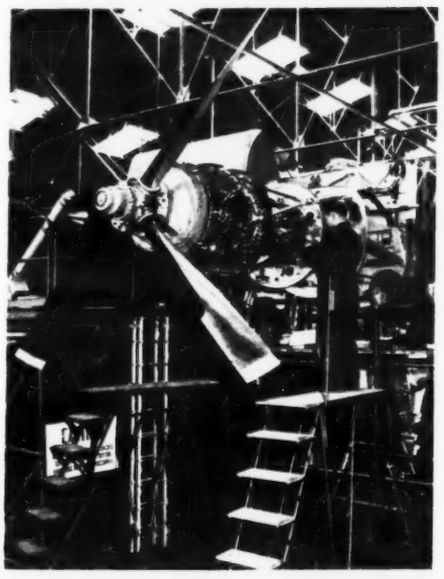
AW.661 version: military transport, also with pressurized fuselage.

Practically the whole of the Hawker-Siddeley Group has been involved in the development of the AW.650 *Argosy* and its sister versions, under the leadership of *Chief Designer E. D. Keen* of Armstrong Whitworth. At a very early stage it was realized that the wing of the Avro *Shackleton* four-engine naval patrol and combat aircraft would serve as an ideal basis for development, and responsibility for modifying—and producing—the wing unit was delegated to *A. V. Roe & Co.* of Manchester. Obviously the wing required structural strengthening at numerous points, and the inboard engine positions were moved further outboard to provide clearance for the larger propellers of the second engine generation *(Tynes). Gloster Aircraft* took part in the detail design of components, such as tail unit, landing flaps, etc., while Air Service Training supplied various ground equipment. Finally, the complete engine nacelles for the AW.650 *Argosy,* including propeller turbines and their Rotol propellers, were taken over unchanged from the Vickers *Viscount* design, by agreement with Vickers and Rolls-Royce.

The heart of the design, the *fuselage* with its long, uninterrupted loading area, was handled entirely by *Armstrong Whitworth.* Its chief feature is its large flat floor, 46 ft. 8 ins. long, 10 ft. wide (bigger in the AW.670/671) and only 4 ft. above ground level, with loading doors both fore and aft. These two one-piece doors open sideways; for the pure passenger or mixed versions two toilets can be fitted inside the rear door if required. To facilitate the loading of heavy freight the floor contains several rows of rollers, which can be reversed to form a flat floor when passengers are carried. In the mixed passenger/freight layout, freight is always placed in the forward part of the fuselage, and passengers behind, to ensure that passengers are not injured by the freight in the event of an emergency landing. The flight deck for the two-to-three-man crew is situated high above the fuselage nose, and like the freight hold and passenger cabin is pressurized, with a maximum differential pressure of 5½ p. s. i.

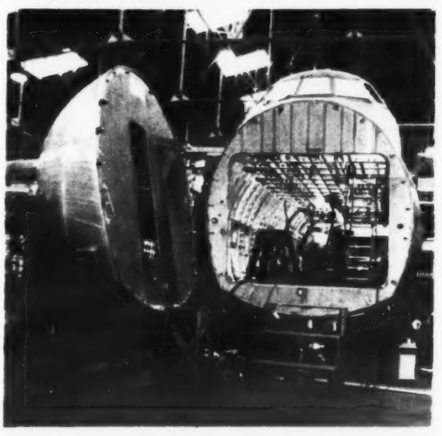


The mockup of the flight deck.



The complete *Argosy* engine nacelles were taken over from the *Viscount:* Rolls-Royce *Dart RDa. 7/2* propeller turbines; Rotol propellers.

The fore and aft loading doors in the *Argosy* open sideways, giving unrestricted access to the full width and height of the freight compartment. On the port wall is the ladder leading to the flight deck.



Other structural features include tail booms of semi-monocoque construction (a special development by Armstrong Whitworth), relatively wide set; hydraulically operated double slotted flaps; tab-operated control surfaces with tension regulators; retractable nose-wheel undercarriage (Dowty design) with three groups of twin wheels (Dunlop); hot-air de-icing for the wing leading edge; Spraymat de-icing for engine and tail unit (Napier); pressurization equipment (Normalair and Godfrey).

For tourist operations either fixed or folding seats can be fitted, in rows of six abreast. The latter variety need not be removed when freight is carried, but are simply folded against the side of the cabin. A total of up to 77 passenger seats can be accommodated, at a pitch of 34 ins., in the AW.650's normal fuselage, plus two toilets and a galley. Mixed versions, e. g., for 36 passengers plus a corresponding freight load, are in preparation. Maximum permissible payload is 28,000 lb. on stage lengths of up to 600 nautical miles (without reserves); and about 10,000 lb. of payload can be carried over the maximum range of roughly 2,400 nautical miles.

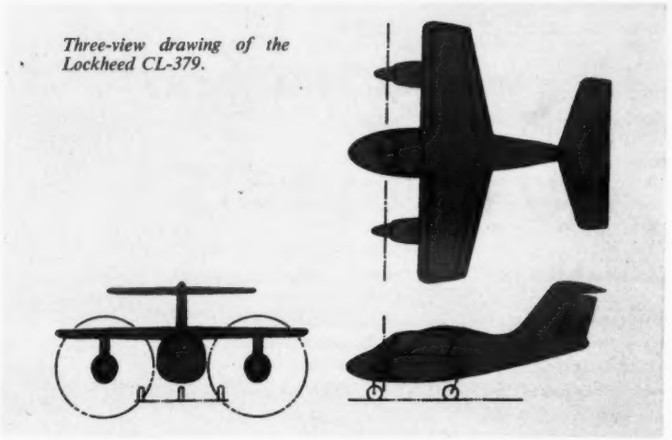
Other technical details and performance figures are given in the accompanying box. Note in particular the moderate take-off field length at full load, which will enable the *Argosy* to operate from practically any existing airport.

Progress in Pictures

The first de Havilland Comet 4B *for BEA nears completion: fuselage and wing unit were mated, and some of the equipment installed at the de Havilland Aircraft Company's Hatfield plant in January. The 4B model has shorter wings and a longer fuselage (by 78 inches) than the* Comet 4, *can carry up to 102 passengers over stage lengths ranging from 400 miles up to more than 2,000 miles and will be operated by BEA on its European and Near East routes.*

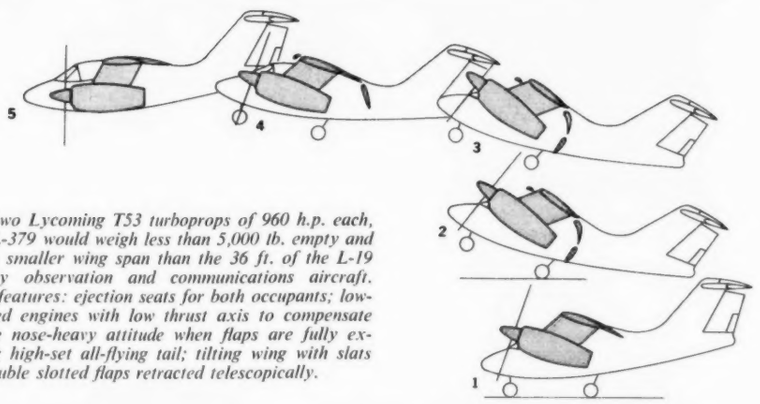
As a result of the technical and commercial successes achieved with its SO.1221 Djinn *and SE.3130* Alouette II, *Sud-Aviation's La Courneuve plant some time ago began the development of a transport helicopter with three Turboméca gas turbines. This first large French helicopter bears the designation SE.3200, and its civil version will have accommodation for 28 passengers; the military version can be certificated for all-weather operation. Fitted with a four-blade rotor, the SE.3200 is almost completed and is scheduled to begin flight testing shortly.*

The Hiller X-18 tilt-wing research aircraft, built at Hiller Aircraft Corporation's Palo Alto, California, plant, is now undergoing flight tests. It is powered by two Allison T40 turboprops with a total of 11,070 e.h.p., and can take off or land horizontally, obliquely or vertically, depending on the setting of the wings. During vertical take-off lift is supplied solely by the large-area three-blade contra-rotating propellers (and the turboprops' residual thrust). The gas pipe beneath the fuselage feeds the differential nozzles at its rear with hot compressed air to provide control about the transverse axis. With its gross weight of 16½ tons, the X-18 is the United States' biggest VTOL and STOL aircraft and is described as a forerunner for a heavy VTOL/STOL transport, which would also be capable of taking off normally with increased payload. The X-18 prototype's flight testing will be followed with interest.

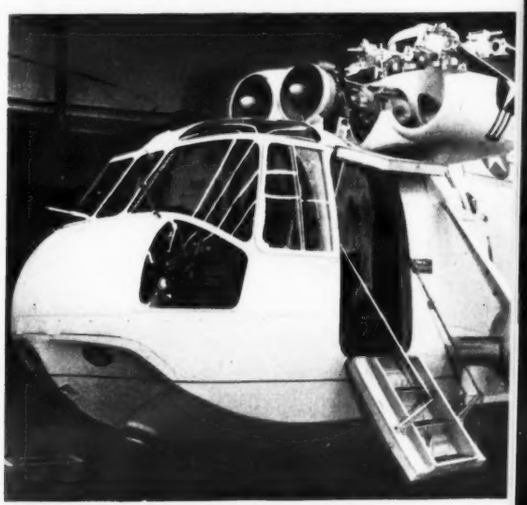


Three-view drawing of the Lockheed CL-379.

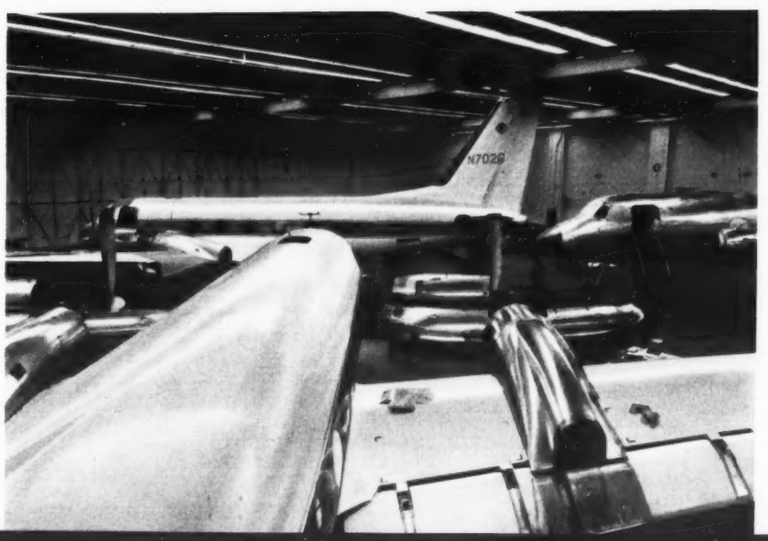
This project for a multi-purpose STOL aircraft with tilting wing was submitted to the U.S. Army by Lockheed Aircraft. Provisionally designated CL-379, the Lockheed design has been subjected to extensive stability and wind tunnels tests, which have revealed that the CL-379 can take off and land almost vertically with wing tilted only slightly upwards, if the wing slats and flaps are fully deflected. Take-off procedure is as follows: engines are started with the aircraft level, the wing at zero incidence, and the propellers and wheels braked, next the wing incidence is raised to full-up position, the propeller brake released, and functional tests performed. Then the flaps and slats are extended, and the throttle advanced. The aircraft nose is raised to 20° by pulling back on the stick, whereupon the aircraft with full throttle setting can take off almost vertically. For transition to level flight the flap setting is reduced and the nose lowered. As speed increases the wing incidence is reduced to zero. Procedure for a short take-off is similar, except that the flaps are extended less far, so that the thrust component is not vertical but directed obliquely downwards.



With two Lycoming T53 turboprops of 960 h.p. each, the CL-379 would weigh less than 5,000 lb. empty and have a smaller wing span than the 36 ft. of the L-19 artillery observation and communications aircraft. Other features: ejection seats for both occupants; low-mounted engines with low thrust axis to compensate for the nose-heavy attitude when flaps are fully extended; high-set all-flying tail; tilting wing with slats and double slotted flaps retracted telescopically.



First pictures of the Sikorsky S-61 amphibian helicopter reveal its flying boat hull, auxiliary floats, folding five-blade main rotor and the arrangement of the two General Electric T58-GE-6 gas turbines, which can be laid bare for maintenance by opening the engine cowling. The versatile helicopter is to be built for the U.S. Navy under the designation HSS-2 and employed on anti-submarine duties. Another version, the HUS-2, is projected for use as a troop transport by the U.S. Marine Corps.



New Grumman trio at Bethpage: three Gulfstream *executive aircraft in various stages of development. Aircraft No. 1 (foreground) and No. 2 (rear left) have already made their first test flights, and No. 3 is nearing completion. The Grumman* Gulfstream *is designed to carry from 10 to 19 passengers and is the first turboprop aircraft to be developed entirely for business use. To date the manufacturers have received 27 firm orders; sales are handled by four agents in the United States and Canada.*

Rockets, Missiles and Space Vehicles

• Russia's artificial planetoid

The Russian space rocket "USSR 1959", launched at the beginning of January, has since passed through the perihelion of its orbit round the sun (90,970,000 miles) travelling at a speed of 20 miles per second. It is now moving towards the aphelion of its highly elliptical orbit. Soviet scientists have calculated that the satellite will circle the sun in about 15 months and approach the earth again after about five years. On its outward journey, 36 hours after launching, it passed within 4,660 miles of the moon at a speed of 1.53 m.p.s.

No official statements have yet been made on the configuration of the vehicle. It appears to be the final stage of a large, multi-stage carrier rocket. Total weight of final stage is given as 3,245 lb., and the instrument payload is said to be 79.5 lb. The instruments were designed to make the following observations: 1. ascertain the moon's magnetic field (if it has one); 2. study the variations in intensity of cosmic rays outside the magnetic field of the earth; 3. record photons in cosmic radiation; 4. determine the moon's radioactivity; 5. measure the distribution of heavy nuclei in cosmic radiation; 6. ascertain the gas components of interplanetary matter; 7. investigate corpuscular solar radiations; and 8. study meteoric particles.

In addition to its measuring instruments, the satellite carried transmitters for the frequencies 19.993 Mc/s, 19.995 Mc/s, 19.997 Mc/s and 183.6 Mc/s, which were used both for tracking the vehicle and for data transmission back to the earth. The 19.997 and 19.995 Mc/s transmitters broadcast telegraphic information for periods of between 0.8 and 1.6 seconds, at unstated intervals, the 19.993 Mc/s transmitter similar information for periods of 0.5 to 0.9 seconds, and the 183.6 Mc/s transmitter sent special data and served to track the vehicle. Transmission ceased after only a few days, either because the transmitters ceased operation, or because transmissions were too weak to be received over such a distance. However, even during this short time extremely interesting data were recorded.

The payload also included equipment for emitting sodium vapours, which form a small, short-lived cosmic cloud (the Soviet press refers to an artificial comet). Clouds of this kind can be recorded optically and photographically and could be used, according to Soviet scientist Pavel Shmakov, as "reflectors" for television transmissions around the globe.

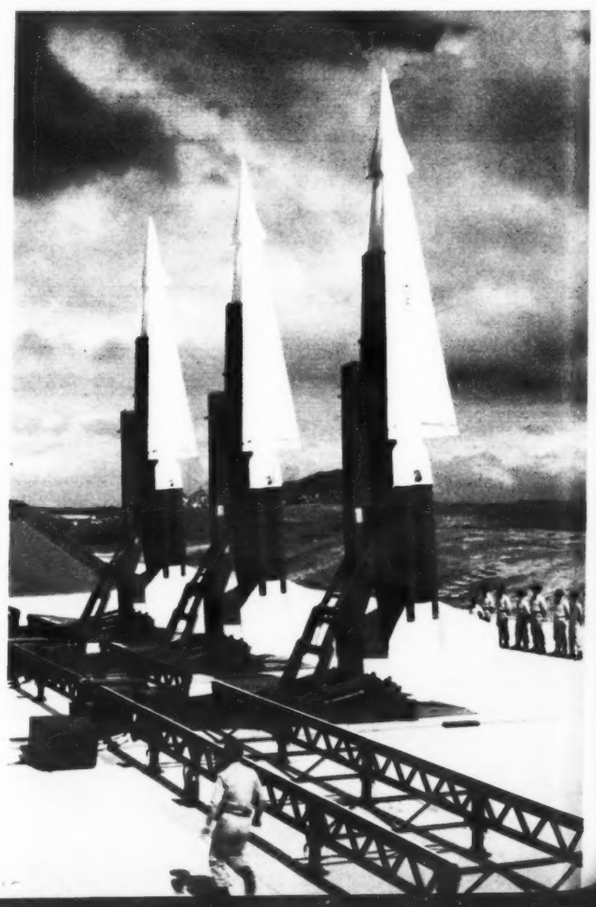
• Van Allen report on space radiation research

In a paper delivered to scientists in Washington, Dr. James A. Van Allen, Director of the Physics Department of the State University of Iowa, reported on the latest space radiation data acquired from the U.S. Army's lunar probe *Pioneer III*. According to the data available from *Pioneer III*, which carried two Van Allen counters to a peak altitude of 63,000 miles, the earth is surrounded by two separate radiation belts or "shells", both containing high radiation. The instruments recorded more than 10,000 particles per second, with a peak counting rate of 25,600 per second in the upper shell.

The first shell extends from 1,400 to 3,400 miles altitude; the second extends from 8,000 to 12,000 miles altitude. Both shells have their maximum thickness in the equatorial latitudes, tapering off in the polar latitudes. Dr. Van Allen said that the particles are either protons or electrons, with preliminary evidence favouring the latter. If the particles were electrons, the maximum density within the belts would range from 5 to 10 röntgens per hour, but at a point midway between the two belts (6,000 miles) the counting rate recorded dropped to 0.3 röntgen per hour. "Thus a man might circle the earth at that distance safely for a considerable period of time, as far as radiation dangers are concerned." Van Allen's work is of crucial significance to the U.S. man-in-space programme (Project Mercury). By showing the actual particle flux in the two belts as well as the dependence of the particles on the earth's magnetic field in which they are trapped, Van Allen has opened the door to the possibility of lightweight shielding arrangements.

*

Above: Nike Hercules on the transport trolley of the transversal rig. The trolley together with the rocket is lifted onto the launcher and serves as a kind of launching guide.



Right: Nike Hercules anti-aircraft rockets in firing position on their launchers. Three to four launchers are connected by a transversal transport rig, on which the rockets are moved on to the launchers (in horizontal position) by means of trolleys.

• Nuclear-powered ramjet missile

According to reports from the U.S. capital, Chance Vought Aircraft Inc. of Dallas, Texas, is working on a nuclear-powered ramjet defence missile for employment as a long-duration "alert" weapon. Presumably based on the Atomic Energy Commission's work on the *Pluto* atomic ramjet engine, the Chance Vought concept would compete with the USAF's nuclear-powered bomber proposal as a maximum readiness weapons system. Chance Vought recently lost the competition with McDonnell Aircraft Corp. to provide an advanced carrier-based interceptor for the U.S. Navy, and has also had its *Regulus II* missile programme cancelled, and as a result will have to lay off some 3,500 of the company's 6,000 employees. It seems likely that the Defense Department will pass other development and construction projects in the guided missiles field to the Texas plant.

• Project Bold Orion

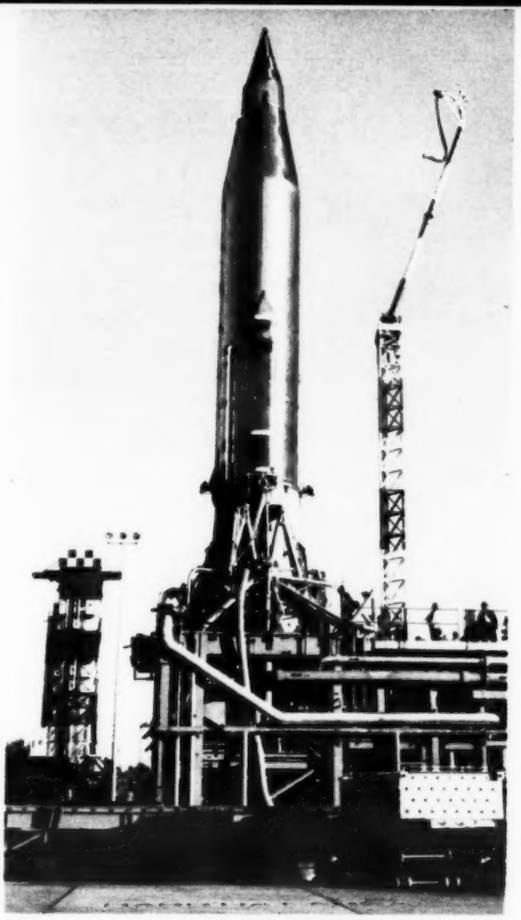
For some time the USAF has been working on the project of a solid-propellant ballistic missile for operation from bombers such as the B-47 or the B-52. It will be capable of about 1,500 miles range. The weapons system, designated WS-199 *Bold Orion*, would sharply increase the useful life of SAC's manned bombers, but the USAF has yet to place a development contract. Principal Air Force fund requests for combat aircraft in the 1960 fiscal year include $900 million for the purchase of 100 additional B-52G bombers and about $750 million for additional Convair B-58 bombers. Recent encouraging developments in tests of experimental air-launched ballistic missiles lend support to the continued emphasis on manned bombers.

Both the Martin Co. and Lockheed Aircraft Corp. have supplied the USAF with experimental air-launched ballistic missiles under the *Bold Orion* programme. Martin has fired both one and two-stage missiles from B-47 bombers. Lockheed, teamed with Convair, has test-fired a single-stage missile at approx. 1,100 m.p.h. from a B-58.

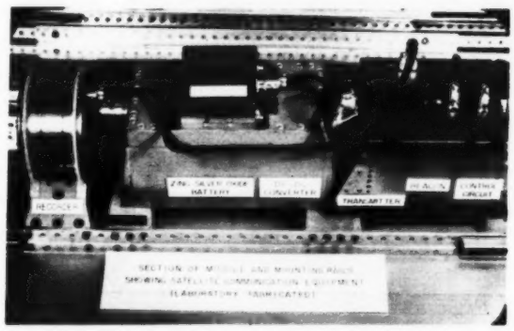
• USAF launches an 8,500-lb. earth satellite

The USAF *Atlas* with radio relay station, launched in the second half of December 1958, was stated by the U.S. Department of Defense to be a complete success. The data storage and playback tests carried out provided important information on the feasibility of using satellites for telecommunication; it also clarified a number of problems connected with the U.S. reconnaissance satellite programme.

The project, which was prepared in the greatest secrecy, bore the designation *Score* (Signal Communications Orbit Relay Experiment) and included a complete *Atlas* rocket which, with a burnout speed of more than 17,000 m.p.h., was guided into an elliptical orbit around the earth. After the launching boosters had been jettisoned and all the fuel had been consumed, the *Atlas* satellite weighed between 8,500 and 8,700 lb., of which 150 lb. was made up of instrument and equipment payload. The 80-ft. long vehicle orbited the earth in roughly 100 minutes at an altitude of between 115 and 625 miles and stayed in space about a month. Its orbit remained within the region between latitudes 32° North and 32° South, so that the satellite never passed over Soviet territory.



Last minute checkups on the *Atlas* satellite rocket.



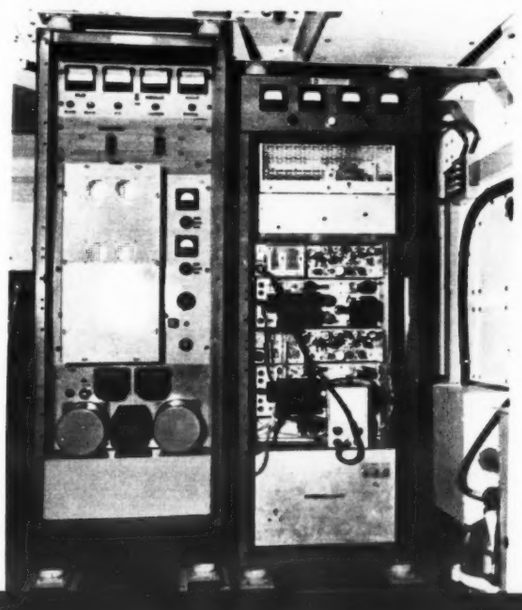
The relay and data storage system, supplied by the U.S. Army for the *Score* satellite, was installed in one of the side bulges of the *Atlas* rocket.

It carried a multi-channel message storage and playback system, which enabled it to store messages transmitted on overloaded frequencies for up to 24 hours, when they were retransmitted back to earth upon interrogation. This equipment included a magnetic tape recorder, for seven telegraphy channels and one voice channel, and a special receiver which triggered the tape and controlled the playback of the information requested from the ground. Playback time was four minutes. *Score* transmitted and received in the 107.97 and 107.94 Mc/s bands.

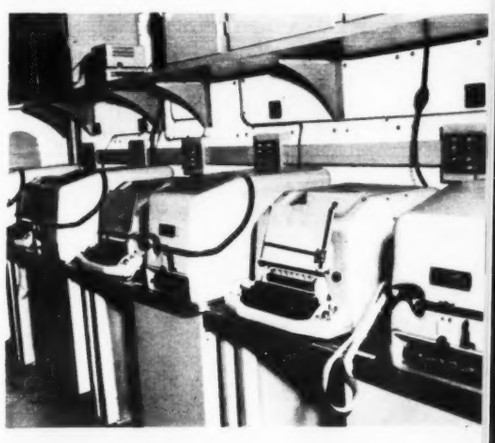
One of the two recording and transmission sets in the *Atlas* satellite suffered a defect in operation. After receipt of a radio command from the ground, the automatic cutout device failed and the whole set of instruments continued in operation, thus exhausting its batteries. The second set of equipment, however, functioned according to programme and was used for an interesting experiment: the transmission of information to SAC bombers with the aid of the satellite. At present SAC uses a complicated, virtually jam-free transmission system which, however, is subject to atmospheric interference because of its low frequency range. The higher frequency band used in a satellite transmitter/receiver system would not be subject to these effects.

In its statement the Department of Defense announced that the heavy *Atlas* missile (approx. 244,000 lb.) was put into orbit by means of a new type of guidance system of very high precision. Whereas, in the case of earlier American satellite launchings, guidance of the carrier rockets had to be previously programmed on the ground, the guidance and control system used in the *Score* project enables corrections to be made to the ascent trajectory after launching. The whole of the experiment was under the control of the Advanced Research Projects Agency. The *Atlas* missile used as carrier vehicle was a standard USAF ICBM with minor modifications.

These U.S. Army ground transmitters used for Project Score were supplied by RCA; left, the power amplifier.



A battery of teleprinters, as used by a ground station of the U. S. Army Signal Corps in conjunction with the Score Project.



The Anti-Missile Missile — A Myth?

By Eric Burgess, Telecomputing Corporation, Los Angeles

As long-range ballistic missiles move closer and closer to operational status considerable thought and money are being expended in trying to develop an effective defence against them. In the United States there has been talk of at least two anti-missile systems, the *Nike Zeus* and the *Wizard*, but both of these are far from being available for production.

The *Nike Zeus* is an Army system which is in prototype form. It has not been ordered into production because, so it is rumoured, the Department of Defense is still not convinced that it represents the best system which the present state of the art can give. The *Nike Zeus* programme has Western Electric as the prime contractor, with the Bell Telephone Laboratories responsible for research and development. The missile itself is to be fabricated by Douglas Aircraft, and there are many sub-contractors as with the ballistic missile programme.

The *Wizard* is an Air Force project which has recently been revived as a back-up to the *Nike Zeus*.

In the USA it is predicted that three or four years are needed to produce an effective anti-missile weapon system. An annual sum of at least two billion dollars will be required over this period for research and development.

The perfection of the missile alone is not sufficient for defence against a ballistic missile. The missile must form part of a complex system made up of acquisition radar, tracking radar, missile tracking and command guidance, launching and checkout systems. The problem of stopping an incoming nose cone is a matter not only of detecting it early enough but also of identifying the nose cone from a swarm of decoys. Its trajectory must then be computed so that its target can be determined and an anti-missile missile launched. Probably the AMM will travel along a contra-trajectory, aiming for head-on interception to explode in the path of the oncoming nose cone so as to embarrass the warhead and cause either its malfunction or its destruction at the greatest distance from the target.

The AMM system resolves into several definite areas of activity: acquisition or detection, identification and tracking, interception and destruction. The first and most important area is that of detection, for unless the incoming nose cone can be discovered quickly enough the rest of the system is useless.

If a defence is to be put into operation there must be time for an AMM countdown to be made and an AMM fired. Even solid-propellant rocket missiles need a countdown because they consist of several sub-systems, for example guidance, control, arming and fusing, all of which must be checked immediately before launching in order to achieve reliability. Even with the simplest of systems this countdown procedure will last several minutes.

Fig. 1 shows the relation between the time of flight and the range of the present generation of ballistic missiles, that is those having ranges up to 5,500 miles or so. For an IRBM of 1,600 to 2,000 miles range the time of flight is approximately 15 minutes, for an ICBM with a range of 5,000 miles, the time of flight is only 30 minutes.

During the final stages of the ballistic flight the missile speeds up so that immediately prior to re-entry it is travelling at a velocity approximately equal to the burnout velocity, also shown on the figure. For the IRBM this is approximately 15,000 feet per second, and it is 22,000 feet per second for the ICBM. Also the IRBM comes in much more steeply than the ICBM, at an angle of about 38 degrees compared with about 27 degrees for the longer range missile.

So the problem of detection is to become aware of the incoming nose cone as early as possible after the missile has left its pad. Time is of vital importance because the ballistic missile is approaching the target at a speed of 170 (IRBM) to 250 (ICBM) miles per minute. The ideal would be to detect the attacking missile as soon as it rises from its pad but this is not possible unless the defence is provided with either advanced observation bases or reconnaissance satellites.

A typical trajectory of a 5,000 mile range ballistic missile is shown in *Figure 2*. The operation of the weapon can be conveniently divided into three stages: powered flight, ballistic flight, and re-entry. The facts that the earth's surface is curved and that most radars are line-of-sight devices, mean that the ballistic missile can "hide" behind the curve of the earth until it is well along its path if the acquisition radar is located at a base near to the target area. Advanced radars are needed.

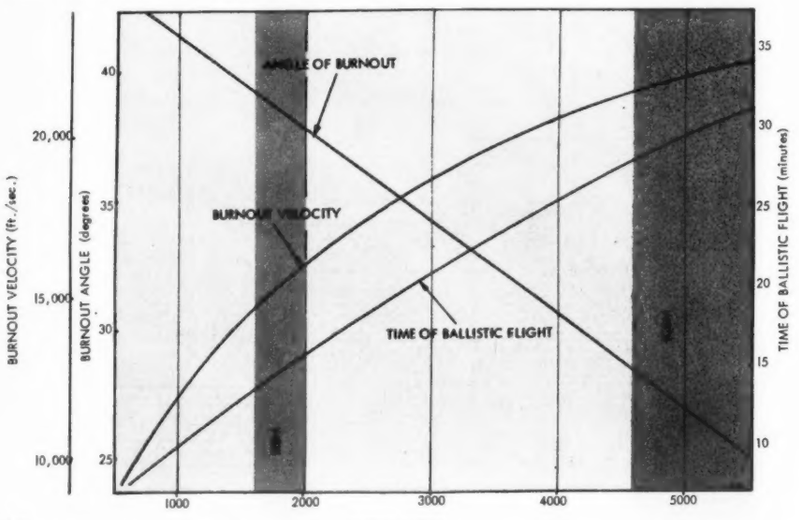
Figure 3 shows the position of two targets, Moscow and New York, relative to potential enemy territory. It is apparent that attack could be made on either target over a wide range of launching sites but that some launching sites would be at a disadvantage as far as early warning is concerned. It is also clear that the United States has a better chance of early warning if bases are established in the Arctic islands, in Greenland, Iceland, and in Britain. With these early warning radars, each having an effective range of 3,000 miles, shown as the special advanced radars in *Figure 2*, the U.S. can detect an ICBM very soon after launching, possibly making use of the ionized trail left by the missile during its upward passage through the atmosphere. The Soviets, on the other hand, are at a decided disadvantage from the early warning standpoint. Their early warning must be closer in towards the targets unless bases can be established on the polar cap.

There is, however, one attack strategy that could be used to upset the U.S. deep defence. It is to launch IRBMs against the early warning radar immediately before the ICBMs are launched. The U.S. would then know that an attack was coming but would be without means of determining precisely when and where. The other possibility is to avoid ICBMs and to use submarine-launched IRBMs which would give the defences minimum time for launching their anti-missile missiles. To prevent this type of attack the *Caesar* curtain is being laid along the east and west coasts of the USA. This curtain consists of sonar stations encapsulated in special plastics and submerged in the oceans. These listening posts are connected by cable to the shore control stations and they are capable of detecting enemy submarines at ranges of at least 100 miles. These detectors, coupled with air-to-sea anti-submarine missiles are designed to keep the submarines beyond IRBM range of important targets.

Alternatively extremely long-range ballistic missiles might be employed to overcome the advantage of defence in depth. These might be fired along trajectories which are not optimum and could approach the target right around the earth. In view of the uncertainties about guidance and propulsion capabilities this article will only consider the first generation of ballistic missiles. But it has to be remembered that future defence systems will have to anticipate attack from almost any direction once the guidance and control problems of ballistic space vehicles have been solved.

According to released data, advanced radar is available to detect the ballistic missile at ranges of up to 3,000 miles, then the tracking radar must follow the missile and pass the tracking data to computers so that the trajectory can be accurately determined. Extremely rapid data processing is needed and this will need careful programming and adequate computer facilities. Assuming the best possible case of detection soon after the ICBM leaves the pad, the defences have only 30 minutes to operate. During this time the first

Fig. 1: *Characteristics of the ballistic missile: burnout velocity, angle of burnout vector and time of ballistic flight plotted against range, for typical first generation IRBM and ICBM.*



job after detection is for the tracking radar to determine the elements of the trajectory. Because of the similarity between many long-range ballistic paths, this trajectory determination needs separate observations and it may take about five minutes to complete.

Then the AMM must be readied. Although these missiles will have to be maintained in a condition of constant alert, even with solid propellants there is an appreciable countdown for reasons already mentioned. This readying of the various sub-systems could occupy a further five minutes. Ten minutes after launching, the nose cone of the ICBM is well along its path and is approaching apogee some 700 miles above the surface of the earth. If the AMM is launched along a contra-trajectory at this time interception will take place ten minutes later, that is 20 minutes after ICBM launch, when the nose cone is on the downward leg of its ballistic trajectory and is about 2,000 miles from its target.

That would represent an ideal interception with the nuclear warheads exploding far above the atmosphere and well away from the target. In practice, though, it is unlikely that events would run so smoothly. It is certainly not permissible to conclude that an attacker will merely have simple warheads and use his ballistic missiles to perform like high-altitude research vehicles. It is expected that the warhead will be protected by countermeasures against the AMM. These may include decoys, missiles launched in front of the actual ICBM, and expandable radar reflectors launched from the ICBM afterbody or from its nose cone. If, after separation of the nose cone, the afterbody of rocket structure, propellant tanks and engines, is disrupted by, say, explosive bolts and centrifugal force, the swarm of broken parts may spread over a front of 30 by 30 miles with random distribution about some mean trajectory which may not be the trajectory of the nose cone itself.

Identification might rely upon the way in which the various bodies re-enter, the nose cone following a characteristic path while the other bodies follow re-entry paths signifying high drag/low mass bodies. Anyway, such decoys may make it necessary to delay the launching of the AMM until warhead identification can take place. Under these circumstances interception will have to take place much closer to the target.

But interception during re-entry is tricky and risky. With close interception there may be hazards of warhead explosion because the incoming nose cone may be fused to explode on change in its environment, for example, a temperature rise caused by the AMM aggravating re-entry heating. The resulting radio-active fallout may reach the target area even though damage from direct heat and blast effects is absent. This is brought about by the characteristics of the re-entry as shown in *Figure 2*. The incoming nose cone follows a very shallow dive towards the target until it re-enters the atmosphere. Then the path curves sharply, and the warhead descends almost vertically onto its target. If interception is made during the re-entry phase the warhead is almost above its target and its explosion some 40 to 50 miles up could be, at least, very inconvenient.

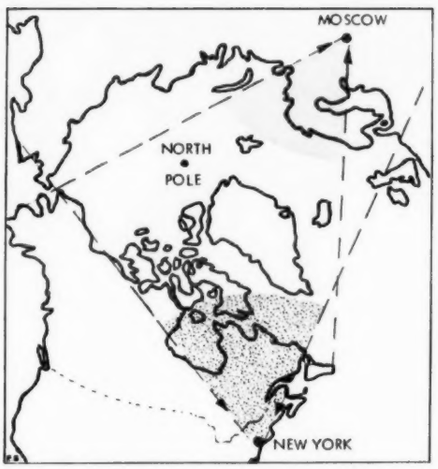


Fig. 3: *Comparison of defence problems for Moscow and New York. The Moscow area could be attacked by ICBMs which could not be detected until very late, on the downward leg of their trajectory. The United States, with bases in Europa and on the Arctic islands, can detect incoming nose cones very quickly. Missiles approaching from e. g. Eastern Siberia or the satellite countries in Europe can be detected almost immediately after launching.*

It is, of course, not difficult to detect the re-entering warhead because re-entry is characterized by several important phenomena *(Figure 4)*. Most modern re-entry designs are believed to use the structure shown in the figure. A plastic laminate forms the front of the nose cone and it may be four to six inches thick. This laminated section changes to an aggregate of plastic and asbestos along the sides of the nose cone where heating is not so severe. The whole is mounted on an internal metal structure within which are the warhead, the arming, fusing and countermeasure subsystems. The re-entering nose cone creates an intense shock front detached from the blunt nose. Behind the shock front is a shock layer in which temperatures reach very high values and in which the air becomes intensely ionized and emits radiation in the visible region of the spectrum. A laminar flow boundary layer is aimed for because any turbulence will increase the heat input to the nose cone. To reduce heat input part of the laminated section is designed to ablate during re-entry. Detection phenomena thus include a cylinder of ionized gas in the wake of the nose cone which can give strong radar echoes, a high temperature luminous region of air in front of the nose cone which can be used for visual tracking, varying amounts of infrared radiation which can be used for tracking.

During *Operation Gaslight*, the recent observation of a *Jupiter* nose cone re-entry, spectral and radiometric measurements were made. All three bodies, the nose cone, the rocket shell, and an instrumented package were detected. They glowed brightly in visible light and were tracked by infrared devices until destruction or plunge into the Atlantic Ocean.

The *Nike Zeus* is reported to depend upon ionospheric disturbance as the nose cone re-enters as a means of detecting and homing on the descending nose cone. The *Nike Zeus* is, therefore, not able to intercept at ranges much exceeding 100 miles because detection would have to take place 200 to 300 miles from the target. Even assuming an extremely flat trajectory and considerable ionization along a long path prior to the main deceleration, detection can only take place about 60 seconds before scheduled impact of the ICBM warhead.

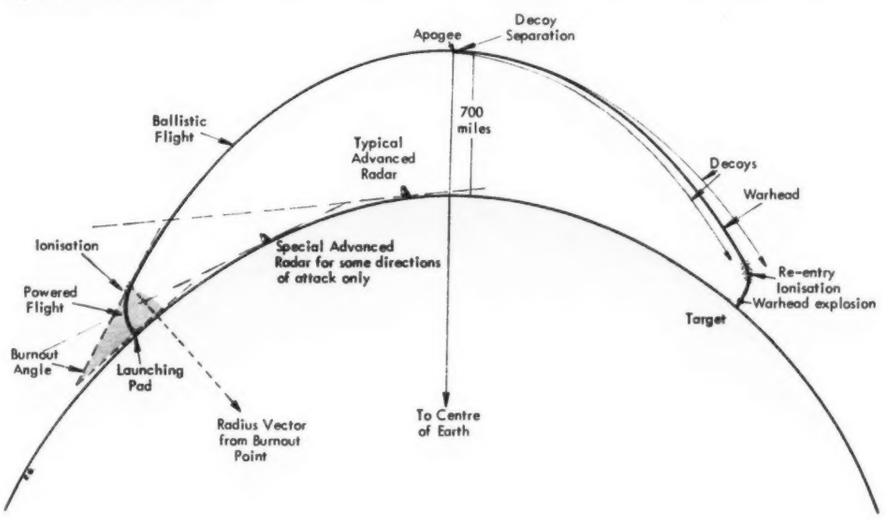
After detection comes the problem of identification. Detection must necessarily become an automatic process in which the detecting radars are linked to a central computing facility which makes the decision when to intercept. Also in the present defence organization where deterrent forms such an important part of defence, it must be assumed that the triggering of the deterrent forces will come from the detection of the incoming warheads. But this can only logically take place when the warheads have been positively identified, otherwise cities are going to be obliterated and the earth plunged into a holocaust by the intrusion of a meteorite or the close wanderings of a planetoid.

Even more serious, as space technology advances and more space probes are despatched on various missions, a certain amount of material must be abandoned in space. Much of this will circle the earth in temporary orbits, orbits which could be uncharted unless strict international control were kept over all space programmes. Sometimes this debris of space missions will re-enter and it could very well be mistaken for an attacking ICBM. Perhaps the overall computer facility will have to be programmed to detect several incoming missiles before it decides to launch retaliation. Certainly it will have to contain adequate safeguards to ensure that innocent incoming matter or failure of an electronic component in its intelligence circuits cannot plunge man into an irrevocable nuclear war.

Interception of the nose cone may take several forms *(Figure 5)*. The most favoured appears to be to explode a fireball in its path and to subject the nose cone to conditions worse than re-entry before its re-entry. Explosion of the nuclear warhead in space (already proved feasible with the recent Johnson Island tests in the Pacific) may spread a neutron swarm that could detonate the ICBM warhead in addition to heat destruction of the protective laminations.

Alternatively the 'last-minute-defence-school' think that to embarrass the nose cone more strongly during re-entry is the best way to ensure destruction. If this explosion takes place before

Fig. 2: *Typical trajectory for a 5,000-mile range ballistic missile. The positions of advanced radar stations as used in U.S. deep defence are also shown.*



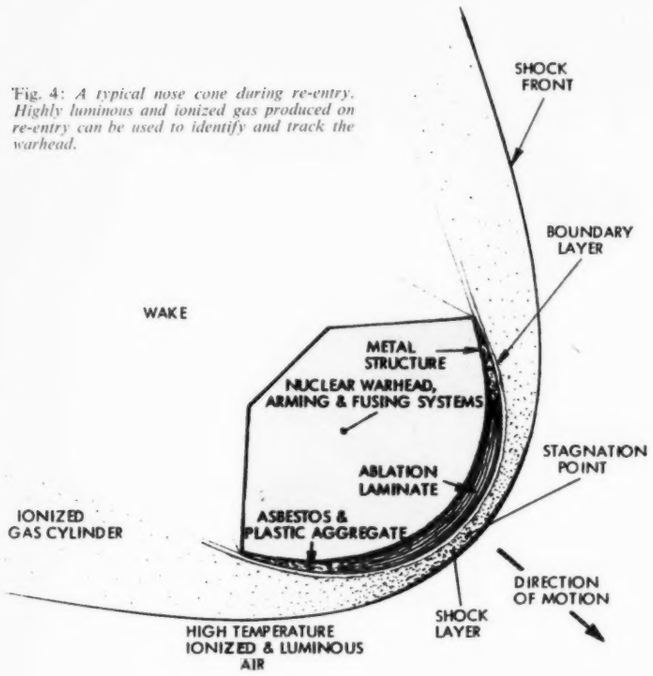


Fig. 4: *A typical nose cone during re-entry. Highly luminous and ionized gas produced on re-entry can be used to identify and track the warhead.*

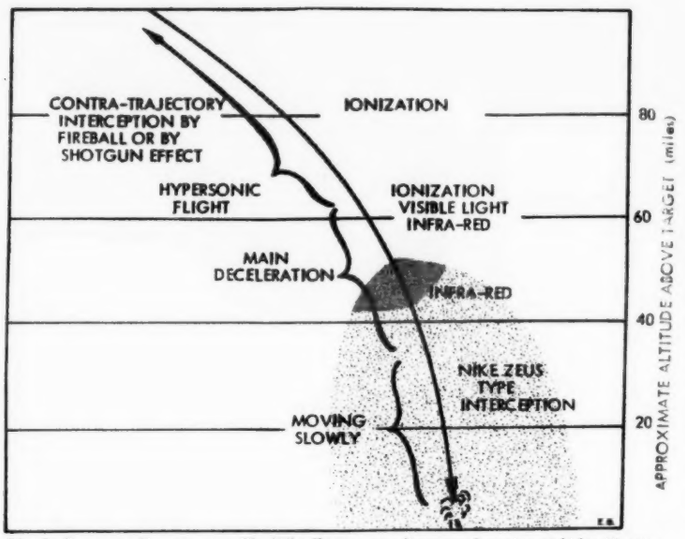


Fig. 5: *Patterns of interception. The* Nike Zeus *type relies upon detection and identification during re-entry, using first ionization effects and then infrared tracking. The nose cone is moving fairly slowly after its main deceleration. Preferably interception should take place earlier and further away from the target. A defence missile launched along the contra-trajectory would destroy the incoming nose cone by spreading a nuclear fireball in its path or by peppering the contra-trajectory with abrasive particles.*

re-entry it will not be a hazard to the target. If it takes place during re-entry it could still be damaging from fallout.

Interception might also take place by a shot-gun effect, a peppering of abrasive particles to move along the contra-trajectory. These would have to travel at the same velocity as an ICBM and accordingly would have a high relative velocity when they met the nose cone. This shot-gun technique could be used to dispose of both nose cone and decoys, in fact, anything moving along the ballistic path to the target from a certain launching point. To do this the abrasive material would have to be spread over a large area and it then becomes a matter of optimizing abrasive particle density. A lot depends upon the size of the AMM needed to launch the abrasives into the contra-trajectory and the amount of payload that can be carried. A really effective defence would appear to require vehicles as large as the ICBM. This is where the new generation, solid-propellant ICBMs, such as the *Minuteman,* may be applied.

With so much at stake, the originator of a surprise attack is not going to be put off by expense. Otherwise an aggressor with limited resources would have his ICBMs lined up at the retaliation system while a defender would have his aligned on the cities of a potential enemy. So unless the intended aggressor has an adequate supply of missiles there would be hope for the defender. He could emerge from an ICBM conflict with his cities intact and those of the attacker destroyed. But the defender would then be defenceless, his ICBM capability put out of action. Even hard bases can be damaged by direct attack on their areas. The explosion of nuclear warheads will produce such intense earth shock waves that the vibration will upset checkout equipment, control equipment and the human operators. The enemy may still have his launching sites and if he has sufficient missiles he can then launch a second wave to destroy the cities of the defender.

However, no aggressor is likely to make the mistake of going to war unless he has adequate capability. Several missiles will have to be available for each target to ensure reliability and saturation of defences. This sort of war game must be an all-out effort for absolute victory in one blow. There can be no second chance.

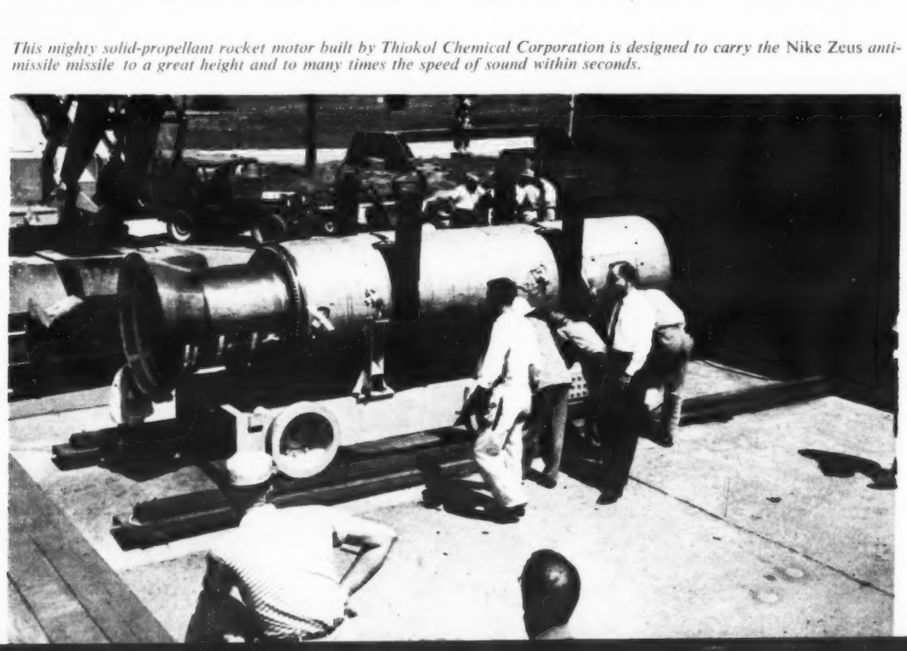
Before an ICBM attack can profitably be launched the force of ICBMs must be great enough to saturate the defences of not only the cities but also the deterrent bases and advanced radars. All power of retaliation has to be destroyed from the word *go*. This includes control headquarters, detectors, launching sites, submarines at sea and aircraft in the air. It calls for an all-out attack with conventional warplanes, anti-submarine devices, IRBMs and ICBMs. Accordingly, any anti-missile system must form part of an overall defence strategy, a complex of defences against all forms of attack. *So far the anti-missile is very much a myth.*

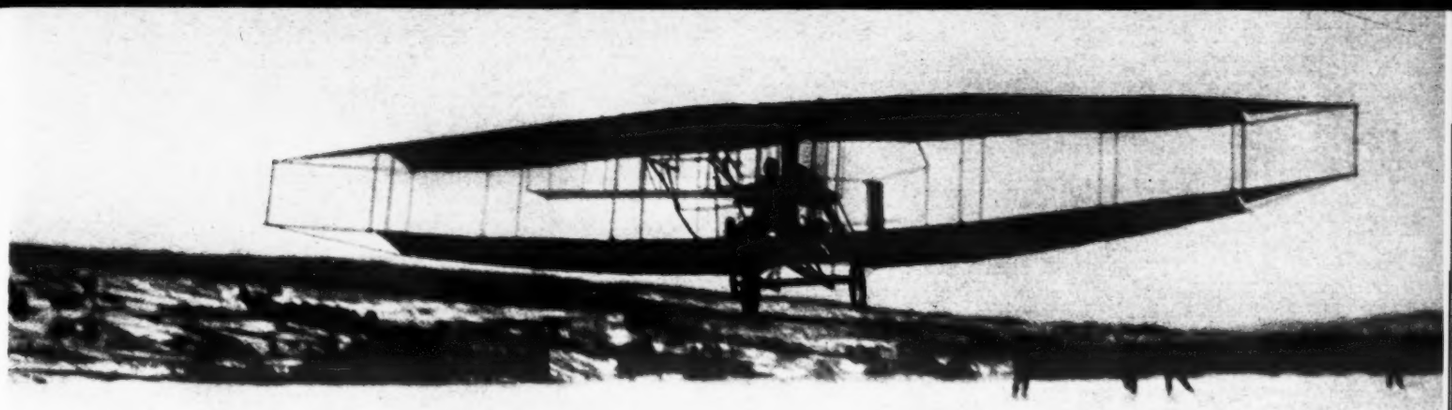
Although several proposals have been made and work commenced on at least two systems, these do not appear to be adequate defence systems. They may be compared with the *Nike Ajax*, a sop to public opinion. The *Nike Ajax*, for example, was quite unable to defend American cities against Russian high-flying bombers such as the *Bison*. For several years it was boasted as placing the important defence areas and cities under invulnerable missile screens. Yet only recently has a start been made to place *Nike Hercules* and *Hawk* missiles in the defence rings. Similarly any missile which attempts interception during or after re-entry is not adequate to protect American cities against a nuclear ICBM attack. The *Nike Zeus* appears to belong to this category.

For one thing the *Nike Zeus* does not appear to possess the energy capabilities of intercepting far enough away from the target. This is because of fundamental size limitation and also because it appears to be planned that identification will take place before the launching of the AMM. The ideal system would be to launch the missile immediately after detection so that it is moving along the contra-trajectory and then to feed information about identification to it during its flight. In this way a few stray meteorites might be destroyed, but certainly no nose cones would penetrate close to the targets. There is, however, one difficulty; the nuclear warheaded AMM moving along the contra-trajectory would finally reach the launching site of a potential enemy. If it were a false alarm provision would have to be made for the AMM to be destroyed in flight long before it was detected by the potential enemy otherwise he could quickly become a real enemy, and the defender would be the aggressor!

It is concluded that no adequate defence against ICBM is at present available. At best, if we assume ICBM's will be fired we must resign ourselves to becoming troglodytes living in sealed underground cities with recycled atmospheres. Alternatively it might be a good idea to become a little wiser and ensure that ballistic missiles are never fired in anger.

This mighty solid-propellant rocket motor built by Thiokol Chemical Corporation is designed to carry the Nike Zeus *anti-missile missile to a great height and to many times the speed of sound within seconds.*





Canada's Aviation, 1909-1959

By Ross Willmot, Don Mills, Ontario

On February 23rd, 1909 John A. D. McCurdy took off from frozen Baddeck Bay in his *Silver Dart* for Canada's first powered flight. *(Courtesy and copyright: the Bell Family and National Geographic Society).*

On the face of it, Canada's aviation world has little reason for celebration at the present juncture. This 50th anniversary year of Canadian flight is a critical one for the country's industry and transport alike. Canada's self-sufficient industry capable of designing, adapting and mass-producing front-line aircraft and their powerplants is being integrated with its U.S. counterpart for defence purposes. Canadian airlines and operators uncertainly face a future of more unrestricted competition and less government protection.

Industry and transport leaders are nonetheless gathering this February 23rd in a tiny Nova Scotia village to honor the dean of Canadian aviation, the Hon. John A. D. McCurdy. In his own experience, McCurdy epitomizes the history of Canadian aviation from the first flight to the last war and after. As the oldest of the old-time pilots, he is a world aviation figure. He is associated with a surprising number of flying "firsts" which brought honor to him personally and to Canada.

At Baddeck the first flight in Canada (and one of the first if not the first in the British Commonwealth) will be re-enacted this February 23rd with fitting ceremony. McCurdy's *Silver Dart* aircraft, which he designed and built himself, thus starting the Canadian aviation industry, has ben faithfully rebuilt to fly again for the occasion.

Contrast of the *Silver Dart* with the latest products of the Canadian industry, the Avro CF-105 *Arrow* interceptor and the Canadair CL-28 *Argus* submarine hunter, illustrate progress made in Canada. Each in complicated speciality of design is a far advance from the simplicity of the *Silver Dart*. Their take-off and landing runs are about the length of the *Silver Dart's* first flight of under a mile. The range of the *Argus* is 4,000 miles (and that of the long-range *Arrow* still unreleased) while the *Silver Dart's* longest flight was only 20. The speed of the supersonic *Arrow* (sufficient according to its makers to win easily a world's speed mark) is beyond comparison with the *Silver Dart's* top speed of 40 m.p.h. The control systems of these modern aircraft could not be foreseen in the *Silver Dart's* elementary flying controls, revolutionary as they were at the time. The modified 35-h.p. motor cycle engine of the *Silver Dart* has been developed to the powerful Orenda *Iroquois* jets of the *Arrow*, each generating about 22,000 pounds thrust.

McCurdy's *Silver Dart*, like both *Arrow* and *Argus*, was an advance and development on aircraft previously known. It incorporated everything learned by the three associates of McCurdy, F.W. "Casey" Baldwin, a fellow Canadian engineering graduate, Glenn Curtiss, a noted U.S. engine builder, and Lt. Thomas Selfridge, of the U.S. Army, who under their mentor, Dr. Alexander Graham Bell, inventor of the telephone, constituted the Aerial Experiment Association. Each had designed, built and flown an aircraft which had contributed to the state of the then little known art. Doctor Bell, who had originated the international group, had contributed supervision from his aeronautical laboratory as well as various work on kites and gliders.

The *Silver Dart* embodied such new and important features as three-wheel undercarriage, tapered wings and a greater degree of aileron control. It looked like a giant albatross and was covered with a silver gray rubber-impregnated silk devised by the associates – hence its name. It was powered by a new water-cooled engine devised by Curtiss.

The *Silver Dart* was wrecked that summer of 1909 when McCurdy made an abortive attempt to prove to Canadian government authorities near Ottawa the worth of the aircraft in modern warfare. McCurdy broke his nose in this the only accident he suffered in a hazardous flying career. By this time he was the world's leading aviator with hundreds of flights successfully accomplished.

McCurdy is not only the first of the surviving old-time pilots to have flown in the world, but with the recent death of his friend, Henri Farman, he is now the oldest in years, 73. He is among the first ten to have achieved flight in the world. His early flights were not made to achieve a stunt, to make records, or to make money. They were deliberately made after much experimentation to extend the knowledge of aeronautics.

John A. D. McCurdy (in front with cap) and Glenn H. Curtiss, pioneers of Canadian aviation, in the *Silver Dart*. *(Courtesy and copyright: the Bell Family and National Geographic Society).*

The day after his first flight McCurdy covered a distance of roughly 4 miles. The aircraft is seen here being towed to the take-off point by skaters. *(Photo H. M. Benner: Courtesy and copyright National Geographic Society).*

The Avro CF-105 *Arrow* supersonic interceptor is regarded as a likely candidate for the world speed record. The Canadian Government is to decide at the end of March 1959 whether or not to order the aircraft into production for the RCAF.

Turns in the air were particularly hard to do for pilots in those days, for ailerons were still rudimentary. But McCurdy gave proof of his flying ability and the Association's development of the aileron by being the first man in the world to make a figure of eight in the air. To get together enough money to continue aircraft design and manufacture, McCurdy and Curtiss barnstormed throughout the eastern part of North America. McCurdy became the first in North America to pilot a flying boat, taking off from Long Island Sound. He flew the first aeroplane to Mexico. He also dropped oranges on a target successfully to prove the practicability of bombing from an aircraft. He was associated with the sending and receiving of the first wireless messages from an aircraft.

With the help of the British Government, he opened the Curtiss flying school at Toronto in 1915 to train pilots. McCurdy supervised the training of 600 young Canadians for the Royal Naval Air Service—and did not have a single accident. During World War I he also managed the Canadian branch of Glenn Curtiss' newly-formed Curtiss Airplane and Motors Ltd., also at Toronto. Under his direction a considerable number of the Curtiss JN-4 or famous *Jenny* were produced for training purposes.

After World War I, he continued his interest in aircraft manufacturing by organizing the Reid Aircraft Co. at Montreal. He became President of what became the Curtiss-Reid Aircraft Limited in 1929. Then during World War II he served with the Canadian Government at Ottawa in various senior positions, supervising Canada's considerable aircraft production.

*

Canadian aviation has indeed come a long way since McCurdy first flew at Baddeck 50 years ago. Among the five leading producers of aircraft in the world, the Canadian industry gives direct employment to almost 50,000 persons and indirectly provides work for an additional number twice as large. The Canadian aircraft industry and transport activities together produce goods and services worth half a billion dollars a year. Aviation has become Canada's third largest business in terms of manpower employed, ninth in the total of goods and services it produces each year. In such fields as aerial survey and bush flying, Canada leads the world.

The future of Canadian aviation would seem to depend largely upon its products and services being accepted abroad. In this age of mounting defence costs, Canada realizes it is very difficult to "go it alone" on research for and production of specialized aircraft and engines. Production orders at home and abroad for the CF-100 interceptor, F-86 fighter, T-33 trainer and *Orenda* jet engine have been filled. The fate of the *Arrow* interceptor and its *Iroquois* powerplants is to be announced at the end of March by the Canadian Government, so far as Canadian orders go. The country's leading producers, Avro Aircraft, Canadair and de Havilland Aircraft of Canada, have design and production facilities available for the needs of other countries as well as Canada.

In little more than a year, Canada will have the first airline in the world to operate only with turbine transports. Trans-Canada Air Lines, like other Canadian operators, is investing heavily in these transports, and the Canadian Government plans to spend more than $600 million in the next ten years on development of airports in Canada for them.

Canada is participating actively on an international basis in such advanced projects as space flight, nuclear propulsion and advanced designs. The probabilities that there will be international use for such projects are good.

The pioneering spirit of McCurdy and his interest in international cooperation is very much alive today in Canadian aviation. It would seem to be the country's greatest guarantee of continuing first rank aeronautical and astronautical development.

A Royal Canadian Air Force Canadair CL-28 *Argus* long-range submarine hunter on a patrol flight over the St. Lawrence River, some 50 miles east of Quebec.

LUCERNE
a Centre of the Aircraft Industry

For the past year or more aircraft manufacturers on both sides of the Atlantic have been competing for orders from Switzerland to an extent which would appear surprising if it were not for the well-known fact that the Swiss military authorities have always striven to equip their numerically small Air Force with the newest possible aircraft. The country's own aircraft industry has also made an attempt to supply the Air Force's requirements, in the shape of the P.16 day fighter and strike aircraft, which has not, however, achieved the desired success.

As once again the new equipment for the Air Force will ultimately be produced under licence by the Swiss industry, it seems a good moment to provide an account of the chief aircraft plants in the heart of Switzerland, near the Alpine Redoubt, for those readers—probably the majority—who have not so far had the opportunity of assessing the central Swiss arms production potential.

"Lucerne, one of the most beautiful cities of Switzerland, is above all a centre of the Swiss tourist trade (247,000 visitors in 1950). The international music festivals, art exhibitions and sports events offer a wide attraction. Lake Lucerne is a favourite boating area . . ." Such is the description of central Switzerland's most famous cantonal capital, to be found in a well-known encyclopedia. Indeed countless tourists from all over the world connect the name of Lucerne with breathtaking views of Pilatus, the Rigi and the Bürgenstock, or—if the weather was unkind—at least with the covered Kappel Bridge and the Lion Monument.

But that this tourist centre is also the focal point of a very presentable aircraft industry (several hundred jet fighters and military trainers turned out since 1945) is not mentioned, as this fact is known only to a few initiated. Yet one of the plants of the Central Swiss aircraft industry is situated practically in Lucerne: the Federal Aircraft Works Emmen can be reached by tram. And the distance by road from the Kappel Bridge to the second plant, the Pilatus Aircraft Works Ltd. at Stans, Nidwalden, is barely 12 miles. *Interavia* recently had the privilege of visiting these two plants in central Switzerland, to prepare the following illustrated report.

Federal Aircraft Works Emmen

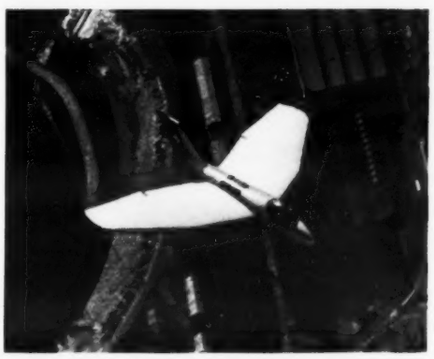
Founded by a Government ordinance dated May 19th, 1942, the Federal Aircraft Works Emmen is answerable to the head of the Federal Military Department's Technical Directorate (KTA). It employs only Federal (i. e., central Government) personnel and must keep its investments and running expenditures within the funds voted by the Federal Councils (Parliament). The organization is run on purely private enterprise lines: it submits estimates to its customers, receives appropriate contracts and presents bills for its actual expenditure—as a Federal concern it is a non-profit-making organization. Main contracts are executed in cooperation with private Swiss firms which work for the aircraft industry—some 600—with whom it signs sub-contracts. Its main task is, of course, the manufacture of aircraft for the Swiss Air Force, but Emmen also works for private companies in special cases and undertakes research projects for both Swiss and foreign clients.

Emmen's many tasks can be broken down roughly as follows:

1. Execution of the Technical Directorate's procurement contracts for all military airframes to be built in Switzerland,[1] whether of Swiss or foreign design, with the aid of the private industry: so far for the C-36 multipurpose aircraft (with 12-cylinder Hispano engine), the DH.100 *Vampire* and DH.112 *Venom* jet fighters, the Pilatus P.2 and P.3 military trainers and finally the DH.115 *Vampire Trainer*. The Emmen plant stands at the beginning and at the end of the production process. It distributes orders to suppliers and undertakes final assembly. In the case of the Pilatus P.2 and P.3 trainers, the manufacturers are the "technical main contractors," and the distribution of sub-contracts is carried out by agreement with the customer. Acceptance testing is done by Technical Directorate test pilots at Emmen.

2. The supply of spares, and repairs and modifications to existing military aircraft under contract to the Technical Directorate or the Directorate of Military Airfields (Aviation and Anti-Aircraft Section of the Federal Military Department): this includes modifications to armament and equipment of all aircraft purchased direct from abroad, e. g., the Hawker *Hunter Mk.6*.

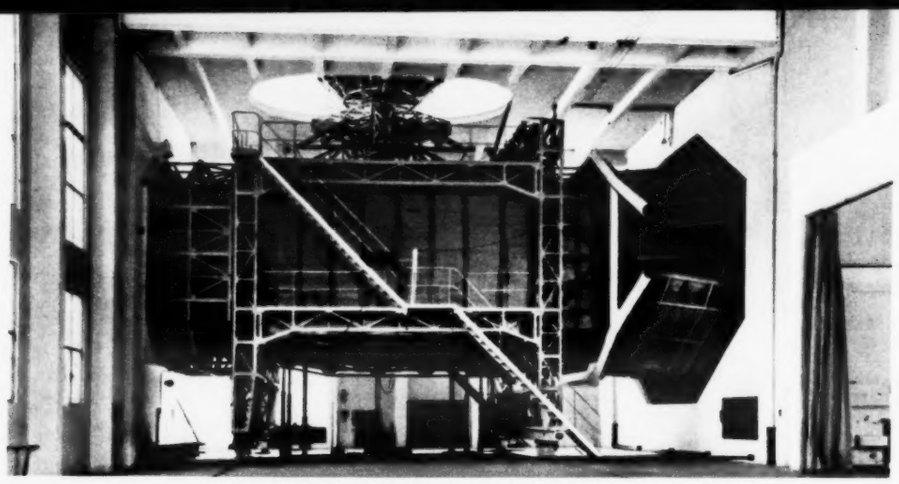
3. Independent development work, i. e., design and prototype construction of aircraft



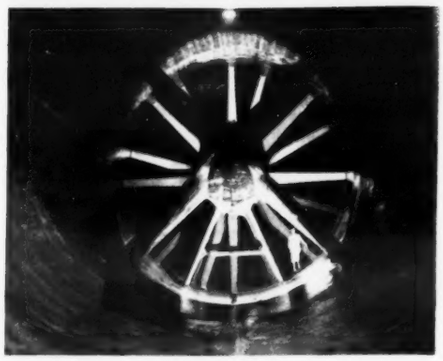
In-flight picture of the N-20 experimental glider.

[1] Powerplants, radio equipment, armament and ammunition are as a rule supplied by the Technical Directorate and made available for installation in airframes. Just as Emmen is main contractor for airframes, so is the firm of Sulzer Brothers responsible for licence production of the jet engines (D. H. *Ghost*).

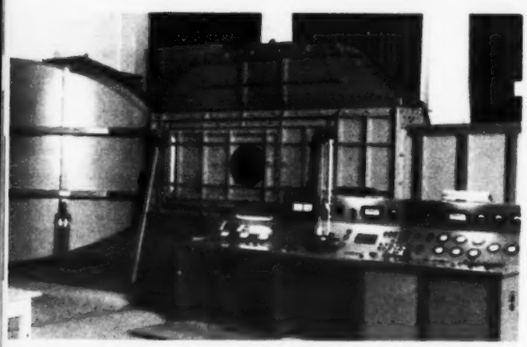
The research and test installations at Emmen: in the rear the large subsonic wind tunnel, with its continuous circuit in a concrete structure: in the foreground the engine test house.



The test section in the large subsonic wind tunnel for flow speeds of up to 260 ft./sec; dimensions (closed) 23 × 16.5 ft.



Blower for the large wind tunnel.

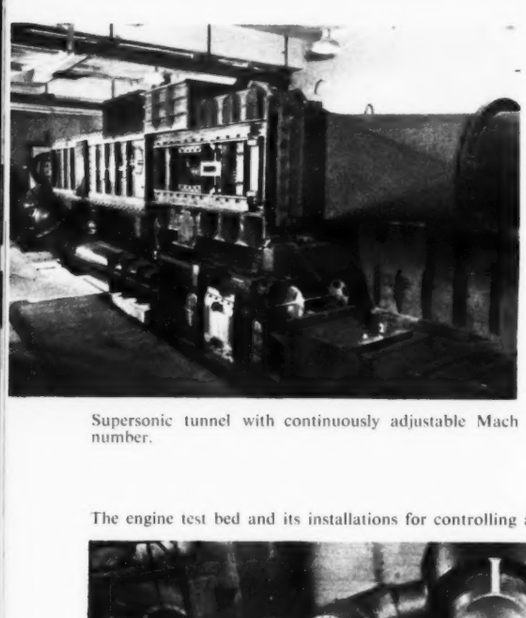


Transonic tunnel for Mach numbers up to 1.2.

Manager Max Buri.

Dipl.-Ing. R. Walthard, assistant manager.

Dipl. Ing. L. Othenin-Girard (Chief Engineer, right) and Dipl.-Ing. H. Kamber



Supersonic tunnel with continuously adjustable Mach number.

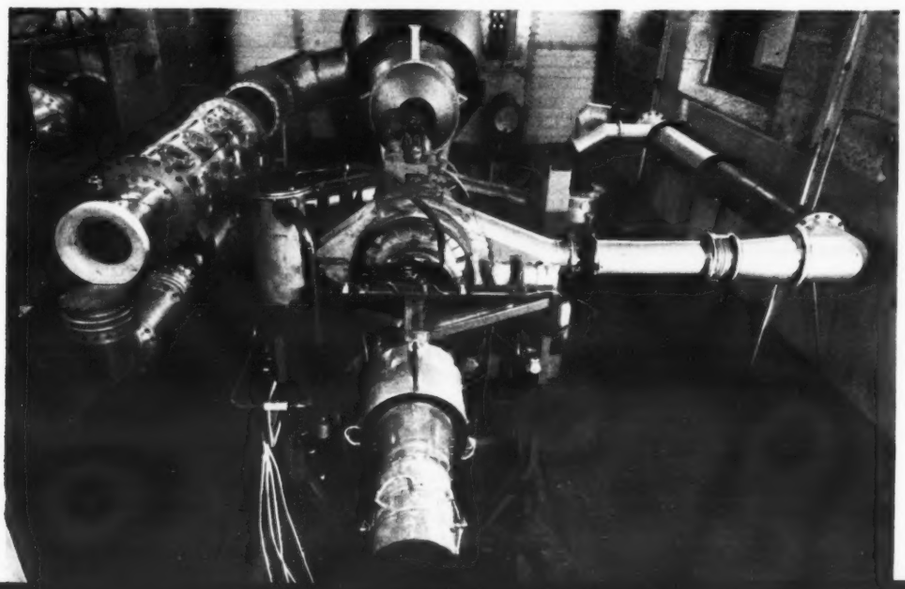
and other military equipment under contract to the Technical Directorate: an excellent example here is the sharply swept "flying wing" type, development of which began shortly after the war. Initially built and flown as a glider (N-20; *see picture*), it was later fitted with four small Turboméca *Piméné* jets of 200 lb. thrust each, and was designed as an experimental model for the very advanced project for a combat aircraft, with four by-pass engines, reheat, thrust reversal and jet deflection. However, development was suspended some six years ago, when the Federal Councils cut funds for this work.

4. Research and development contracts for Federal agencies and Swiss and foreign private customers: with its modern wind tunnels and a large engine test bed with controllable air density and ram pressure,[2] Emmen's research division is capable of undertaking investigations in all fields of gas dynamics. Customers can be sure that absolute discretion will be observed—Switzerland is a neutral country, and the staff will not talk. Emmen refuses to disclose even the names of its customers, and all that it was possible to learn was that "a large number of clients from nine countries" had used the services of the research division during recent years.

The aerodynamic test installations at Emmen—some hundreds of yards away from the production shops at the edge of a wood—will make the heart of any aeronautical engineer beat faster:

[2] Cf. Dr.-Ing. W. Spillmann: "Jet Engine Test Bed for High-Speed Conditions" in *Interavia* No. 5, 1948, p. 263, etc.

The engine test bed and its installations for controlling air density and ram pressure.



Control room for the engine test bed.

The design office at Pilatus Aircraft Works, Stans.

Part of the workshops.

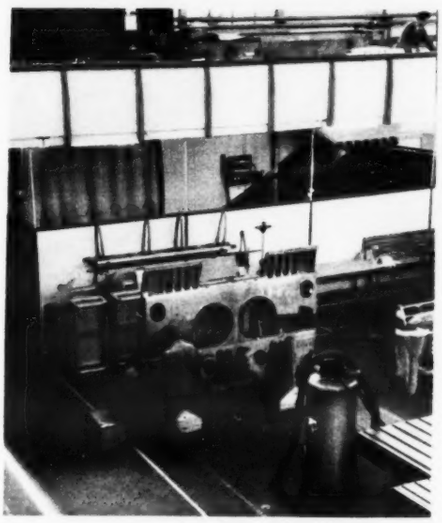
• Large subsonic wind tunnel with closed circuit for flow speeds of up to 260 ft./sec and test sections of 23×16.5 ft. and 26×18.5 ft. (in both cases with oblique corners); power 3,850 h. p.; six-component balance; can also work as a free-flow tunnel.

• Small open subsonic wind tunnel with closed circuit for flow speeds of up to 200 ft./sec, with a test section (open) of 8×5.8 ft. (oblique corners); power 310 h. p.; six-component balance; can also be used as a free-flow spin tunnel, thanks to its vertical secondary shaft 10 ft. in diameter.

• Transonic tunnel with slotted nozzle walls for continuous operation at Mach numbers up to 1.2, with a test section of 19.7×23.6 in.; power supplied by two Rolls-Royce *Nene* jets (shortly to be replaced by an electric blower); six-component balance.

• Supersonic tunnel for sustained operation with continuously adjustable Mach number: the top and bottom walls of the square-section Laval nozzle can be adjusted to give Mach numbers of from 1.5 to 3.8; test section 11×11 in.; model suspended from a sting; forces measured by electrical strain gauges.

The supersonic tunnel forms part of the air supply system for the above-mentioned engine test bed, thus ensuring improved utilization of the latter's compressors. In addition there are many special test beds, for turbo-compressors of axial or radial construction, air intake ducts, coolers, pressure cabins, etc.



A wing centre section for the Pilatus P. 3 military trainer nears completion.

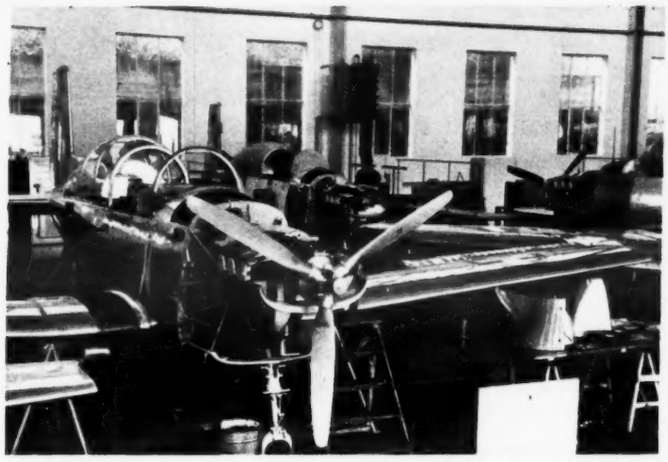
The Emmen plant, under the management of *Max Buri*, today employs around 500 persons, or about one tenth of the total specialized personnel available for aircraft production in Switzerland (1955 figures). Buri's assistant is *R. Walthard*, while Chief Engineer *J. Branger* is responsible for design, and engineers *L. Othenin-Girard* and *H. Kamber* for the research and test installations at Emmen.

Pilatus Aircraft Works, Stans

About halfway along the road from Stans to Ennetbürgen the visitor passes a large military airfield, alive with jets, with broad runway and imposing arrester nets ("rabbit catchers") for aircraft over-shooting. Along the west edge of the airfield and right up against the Bürgenberg hill there are also modern aircraft hangars and office blocks, the plant of Pilatus Aircraft Works, a member of the Oerlikon-Bührle group.

This purely private company was founded on December 16th, 1939, with a share capital of 2,000,000 Swiss francs. Operations began a bare two years later, initially on the overhaul and repair of military aircraft. In 1943 the company undertook the development of a military trainer, the P. 2, as a private venture. This made its first flight in April 1945 and had quite a respectable production run. Finally, to replace the pre-war Bücker trainers, Pilatus developed in 1952-1953 the P. 3 trainer, with Lycoming GO-435 engine, a cantilever low-wing monoplane of all-metal construction, with seats in tandem, full-view cockpit and electro-mechanically operated retractable undercarriage and landing flaps. This development, too, was carried through with entirely private funds and initially without contract from the military authorities. The aircraft was a success: it has been flying since September 1953 and is still in production. It was selected as standard trainer for the Swiss Air Force and ordered in sub-

Bird's-eye view of the Stans aircraft plant: left foreground, the new maintenance hangar: behind it the office block, design office and parts workshops; far right, the metal-working and final assembly shop.



A completely equipped fuselage for the P.3 has already been mated with wings, tail unit, engine and undercarriage (left), while a second fuselage of the same production batch (right) is being riveted in its jig.

Civil version of the Pilatus P.3 trainer: Lycoming GO-435 engine of 260 h. p. take-off rating; gross weight 3,300 lb.; max. speed 192 m. p. h.

General view of the metal-working and final assembly shop.

stantial numbers through the Federal Aircraft Works Emmen.

Most of the sub-assemblies of the P. 3 military trainer's airframe are manufactured at Stans, where final assembly also takes place. Certain sub-assemblies, such as the wings and tail surfaces, and many of the finished parts, such as undercarriage components, electrical servo motors, etc. come from other producers. In addition to the manufacture of aircraft of their own design, the Stans plant has been engaged in recent years in a very extensive programme of parts production for the Swiss licence versions of the *Vampire* and *Venom* jet fighters, under contract to Emmen. Finally, Pilatus carries out overhaul and repair work on military aircraft for the Directorate of

Managing Director and Commercial Director Henry F. Alioth (left) and Technical Director H. Fierz.

Military Airfields and maintains well-equipped maintenance centres at Geneva's Cointrin and Zurich's Kloten airports for non-scheduled operators and sports pilots.

Today the Pilatus plant, including its maintenance services, employs around 400 persons. Managing Director is *Henry F. Alioth*, and Chief Engineer is *H. Fierz*.

Lucerne is thus not only "one of the most beautiful cities of Switzerland" . . . but is also developing, as the accompanying pictures reveal, into the centre of the Swiss aircraft industry, for one reason thanks to the good relations and close cooperation existing between a State plant and a private undertaking.

JET AGE PLANNERS SELECT

COLLINS MICROWAVE

Microwave Systems Relay Radar and Remote Control Information to Enable Constant Enroute Air Traffic Surveillance

Complete Collins Microwave Systems have been designed and are being installed for the Federal Aviation Agency (which includes the former CAA) in its current expansion program to increase air traffic capacity and safety.

The microwave systems are used to relay radar and remote control information and voice communication between long range radar sites and Air Route Traffic Control Centers. Collins is providing systems encompassing equipment for 104 terminals and 181 repeater stations.

Collins was selected over several companies because it could do the job economically with excellent equipment, providing capable engineering assistance for all project phases.

If you have a microwave requirement, large or small, let Collins assist you in evaluating, planning and installing your system.

COLLINS

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Typical radar/microwave station (left) detects all aircraft in a 200 mile (320 km) radius; radar signal is processed and relayed to Air Route Traffic Control Center through Collins Microwave link (tower at left).

FAA technician (below) talks over the service channel at the radar/microwave installation. Both Collins carrier and RF equipment are used at such sites.

FAA and Collins engineers (below) check out a typical Collins microwave repeater station used to link radar/microwave sites to Air Route Traffic Control Centers.

Collins RF and carrier installation (below) at this Air Route Traffic Control Center utilizes two bays to control equipment at two different radar sites.

Radar scopes such as the one pictured below are employed at FAA Air Route Traffic Control Centers to pinpoint aircraft within range of the 200-mile radar sites.

The nerve center (below) of all FAA Air Route Traffic Control Centers utilizes Air Traffic Controllers who keep track of all aircraft in the center's area.

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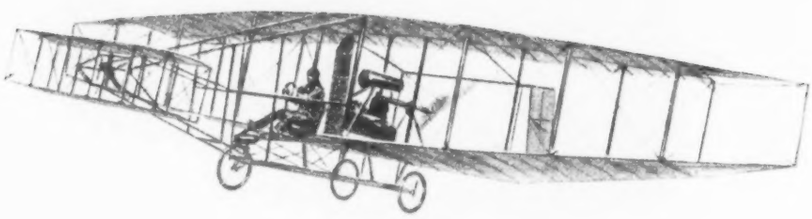
50 YEARS



OF PROGRESS

1909 *First flight of a Canadian airplane, February 23rd, the Silver Dart, piloted by J. A. D. McCurdy, takes off from the frozen surface of Baddeck Bay, Nova Scotia. Historic hop marks beginning of a new era of transportation progress in Canada.*

1959 *First delivery in February of a de Havilland Canada DHC-4 Caribou at Downsview, Ontario. Fifty years after the Silver Dart, the Caribou — the first STOL aircraft in its weight category (24,000 lbs.) — ushers in a new era of cargo/passenger air service to the remote areas of the world.*

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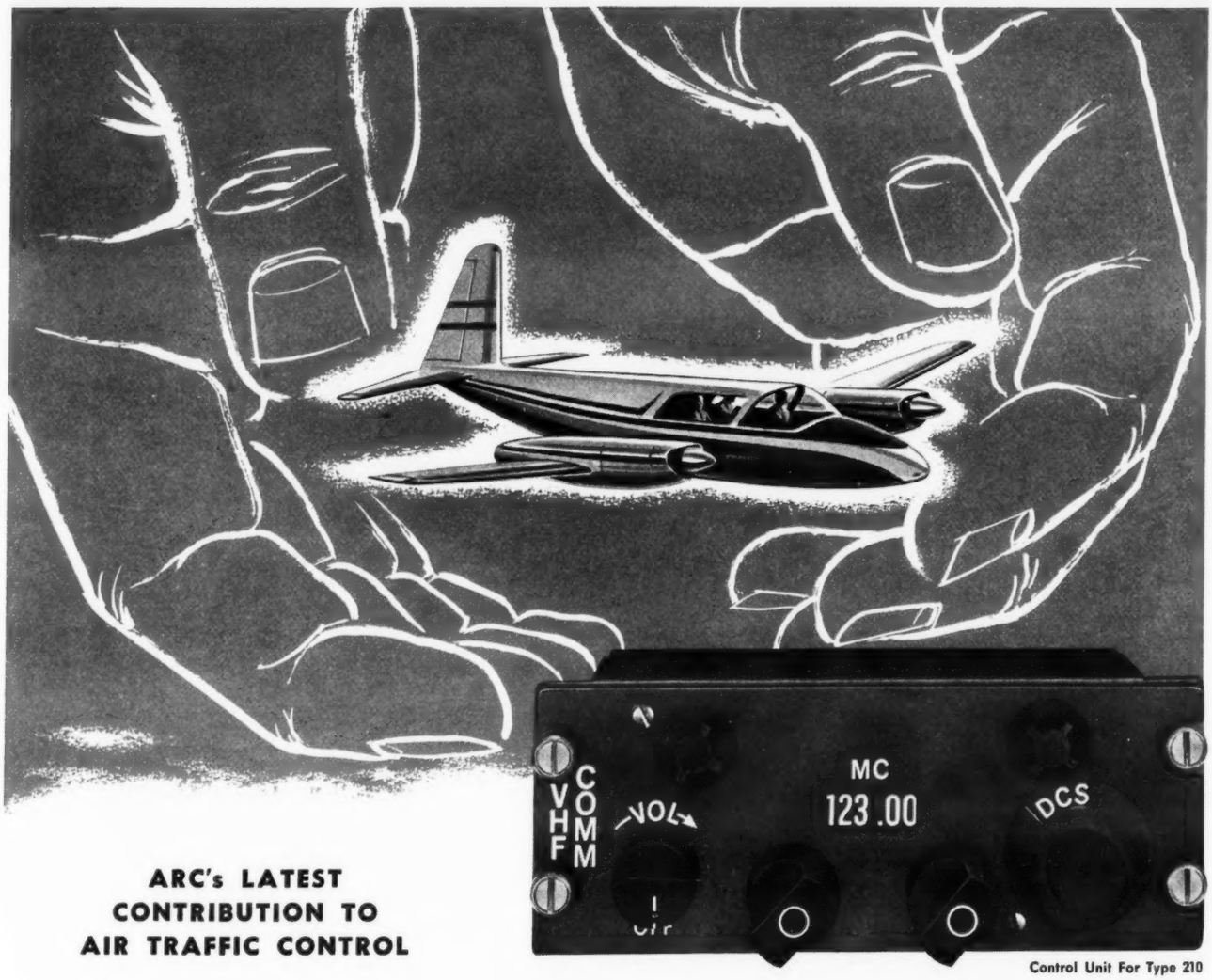

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Control Unit For Type 210

THE 360 CHANNEL TRANSMITTER-RECEIVER TYPE 210

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This is ARC's latest contribution to air safety. Ask your dealer for a quotation to include a single or dual installation, along with other units of ARC equipment listed below.

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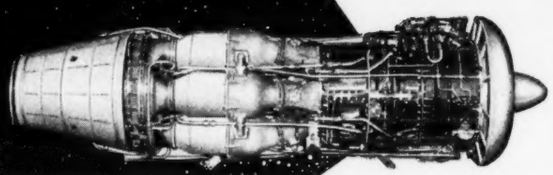

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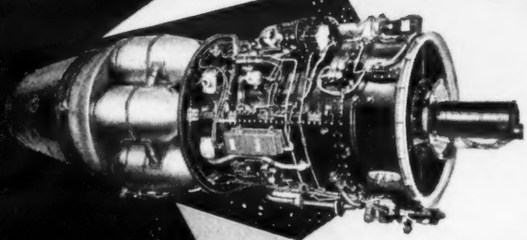
Canada's first gas turbine engine was initially run on March 17, 1948 at 2600 lbs. thrust. Thrust-weight ratio developed to 2:1.



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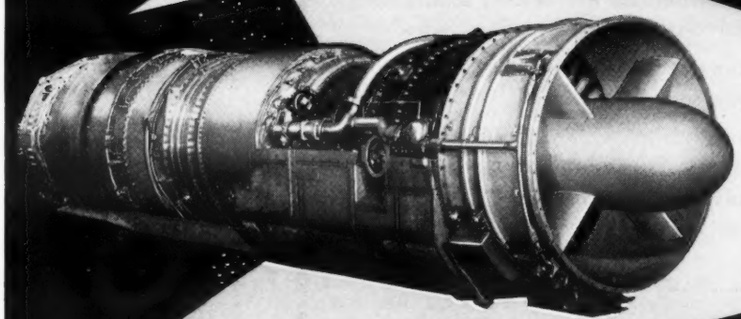
First run on February 10, 1949. More than one million hours of operational service to date in CF-100's and Sabres of the RCAF, West German, Belgian, South African, and Colombian air forces. Thrust-weight ratio, 3:1.



IROQUOIS

First run December 15, 1954. First production Iroquois are for the AVRO ARROW Mark II. Thrust-weight ratio, 5:1

Orenda Engines Limited salutes the 50th Anniversary of powered flight in Canada

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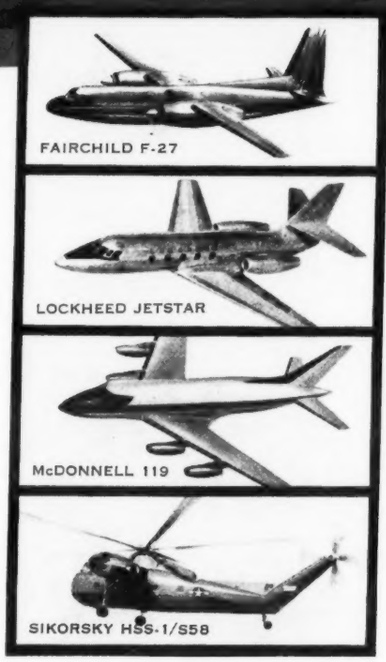

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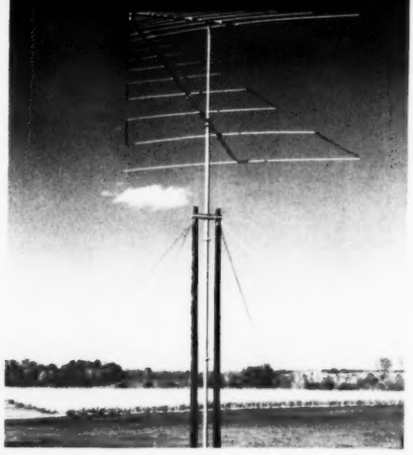


● **Collins Radio Company** is now marketing a new range of HF/VHF antennas providing extremely wide bandwidth. Radiation and impedance characteristics are essentially independent of frequency over bandwidths as high as 10 : 1, and the range could be extended to 100 : 1. The first to be made available is the 237A series, the 237A-1 covering 6.5-60 Mc/s, 237A-2 for 11.1-60 Mc/s, and the 237A-3 for 19-60 Mc/s. All radiate a horizontally polarized, unidirectional beam and provide a free space gain of 8 db over an isotropic antenna. Motor drive provides any azimuth bearing. Designated "Logarithmically Periodic Antennas", the design is based on a structural geometry resulting in the repetition of the antenna's electrical characteristics periodically as the log of the frequency. Since there are only minor changes over each period, the characteristics are essentially constant over the whole frequency range. Theoretically the bandwidth of the Log Periodic structure could be indefinite, but this is limited in practice at the low frequency end by the maximum element size that can be tolerated, and at the microwave end by the fabrication precision available.

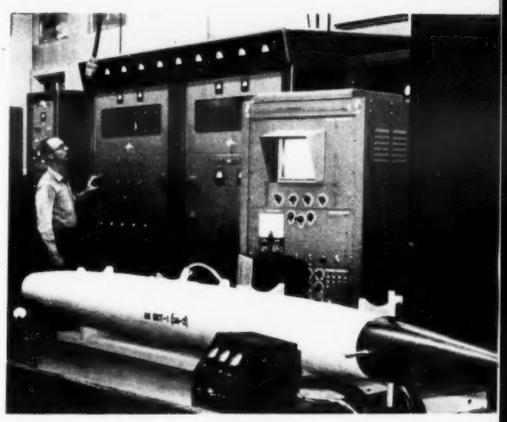
● **Donner Scientific Company,** Concord, California, has announced the development of a new transistorized integrating accelerometer as a key component in several missile and aircraft programmes. The unit is employed both to close a set of contacts at predetermined altitudes and to provide analogue outputs relative to the acceleration and velocity; velocity contacts can be closed at any speed from a few feet per second to 50,000 f. p. s. up to accuracies of 0.25 percent over extended operational periods. Pressure range is 0 to 35 lb./sq. in. absolute, and the temperature range is 30—150°F, and the unit will operate under ± 15 g of vibration through 2,000 c.p.s. Acceleration ranges from ± 1 g to ± 20 g are available, and short shock pulses of 75 g or longer pulses of 50 g are withstandable. Physical dimensions are dependent on specific range.

● **Hoffman Electronics Corp.** is now producing the illustrated portable test equipment designed to check performance of airborne TACAN and DME air navigation equipments. Designated HLI-119, the instrument simulates the operation of the TACAN ground beacon, and makes it possible to check the airborne equipment. Dimensions: 8¾" × 12" × 18½". Weight 35 lb. In Great Britain a similar equipment is being produced by G. & E. Bradley Ltd.

● **Airtron Canada Limited,** Toronto, is offering a wide-band ferrite switchable duplexer which provides a complete transfer in 3 milliseconds from the wide beam to the far-reaching pencil beam. This is done by reversing the current through the magnet coils, thus changing the RF path from one waveguide output to the other.

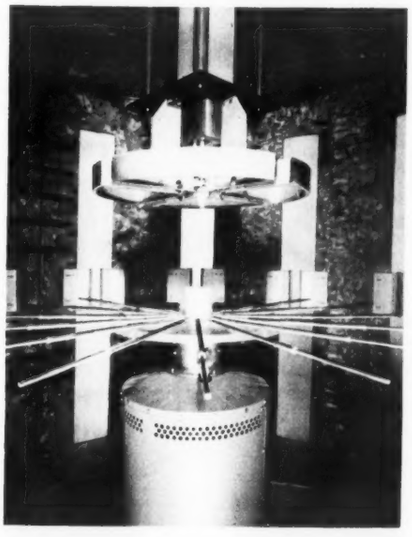
● **Data-Control Systems, Inc.,** Danbury, Conn., announces a new line of airborne telemetry components, including voltage-controlled oscillators in both standard and miniaturized versions. The standard unit offers temperature stability better than ± 1% within a range of 20 to 100°C. The equipment is shock tested to 100 g and vibration specified to 20 g at 2,000 c.p.s. A 10% variation in supply produces less than 1% of bandwidth frequency shift. A lower priced model offers comparable performance, circuit and configuration, but uses germanium transistors, which reduces the upper temperature limit to 70°C. A miniaturized voltage-controlled oscillator (less than 4 cu. in.) uses a single 18-volt DC supply and features a temperature stability better than ± 3% from 20 to 100°C. Distortion is less than 1%, and the unit is shock tested to 100 g; vibration standards are specified at 20 g to 2,000 c.p.s. A supply variation of 10% produces less than 2% of bandwidth frequency shift. This unit is also available with germanium transistors at a lower price (temperature limit 70°C).

● **Marconi's Wireless Telegraph Company** is manufacturing a range of ferrite isolators with very good wide-band match effected with adjoining transmission lines and ability to operate in a wide temperature range without significant deterioration in performance. The tolerance of the standing wave ratio is 1.05 to 1.02 or better, which conforms to CCIR recommendations (CCIR = Comité Consultatif International des Radiocommunications). At present the following versions are available: RD 103 for the 4,000 Mc/s band, RD 105 for the X-band and RD 106 for the 2,000 Mc/s band.



● An airborne television unit which can be used for reconnaissance or for missile guidance has been developed by **Temco Aircraft Corporation,** Dallas, Texas, and is currently being evaluated by the U.S. Navy. Designated "Alpha", the system is employed in conjunction with a video tape recorder developed by Mincom, a division of the Minnesota Mining & Manufacturing Co., and will permit immediate visual review of information obtained during flights, eliminating the time required for film development. The accompanying picture shows the Alpha unit, designed for mounting below the aircraft wings, on test at Temco's Dallas plant.

● Following exhaustive tests, the Ministry of Supply has ordered eleven VOR equipments from **Marconi's Wireless Telegraph Company,** on behalf of the Ministry of Transport and Civil Aviation. The equipment will be installed at selected points on the airways in the United Kingdom. The accompanying picture shows the antenna system, consisting of an omni-directional exciter (top) for radiation of the reference signal and a rotating aerial (bottom) for radiation of a signal whose phase varies with azimuth. The latter comprises a small rotating loop and 16 fixed radial elements, and the whole assembly acts as a half-wave rotating dipole.



Boost Gliders and Atmospheric Entry

By Alfred J. Eggers, Jr.

Ames Aeronautical Laboratory (NASA), Moffett Field, California

The rocket-boosted glider has emerged from the spectrum of long-range hypervelocity[1] *vehicles as the one perhaps best suited for manned flight.*

This development was first anticipated by *Eugen Sänger*[2] who showed that if such a vehicle were boosted to a speed and altitude where aerodynamic lift and centrifugal force are essentially in equilibrium with the gravity force, then the decelerations during atmospheric entry should remain well within human tolerance. Sänger further demonstrated that glide ranges in this "equilibrium" trajectory become an attractively large fraction of the circumference of the earth at flight velocities well below satellite speed, providing the vehicle is *aerodynamically efficient* in the sense that it develops lift which is large compared to the drag.

More recent studies[3] have substantiated and extended these early findings relative to the motion characteristics of boost gliders; however, it has also become amply clear that the attractiveness of any hypervelocity vehicle is determined in large measure by its *aerodynamic heating* as well as its *motion during atmospheric entry*.[3, 4] It is important therefore that we assess the boost glider from this dual point of view, and the remainder of this article will be devoted to this end.

*

It will be helpful to initiate our considerations with a brief review of the motion characteristics of hypervelocity gliders. We note first in this connection that *range* φ in the equilibrium glide trajectory is a fractional value of the earth's circumference given by the relation

$$\varphi = \frac{1}{4\pi}\left(\frac{L}{D}\right) \cdot \ln\left(\frac{1}{1 - v_f^2}\right) \tag{1}$$

where L/D is the aerodynamic lift-drag ratio of the vehicle and v_f is the ratio of its velocity at the end of powered flight to satellite velocity.

We note further that deceleration during the glide approaches a maximum with decreasing speed and altitude, and this maximum is simply expressed in terms of gravity acceleration as

$$G_{max} = \frac{D}{L} \tag{2}$$

It is immediately obvious from these relations that increased L/D is an advantage so far as the motion of the glider during atmospheric entry is concerned, because it yields proportionately increased range

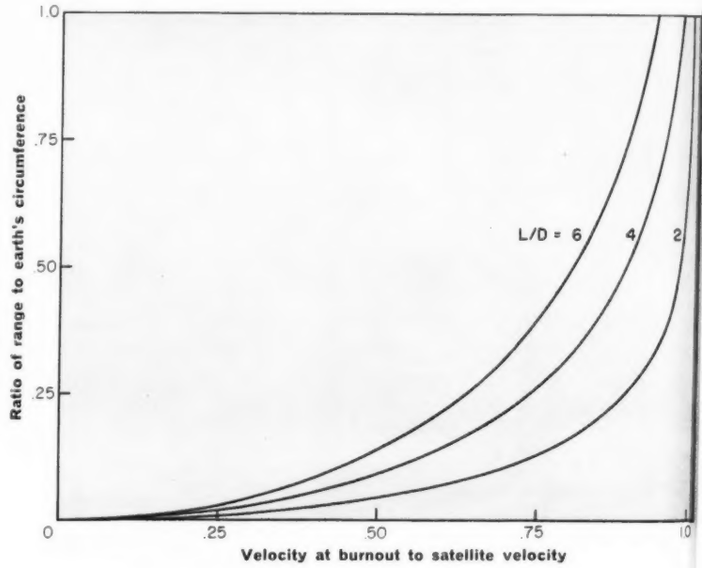


Fig. 1: Variation in the range of rocket-boosted long-range gliders as a function of burnout velocity (abscissa) and lift-drag ratio (parameter).

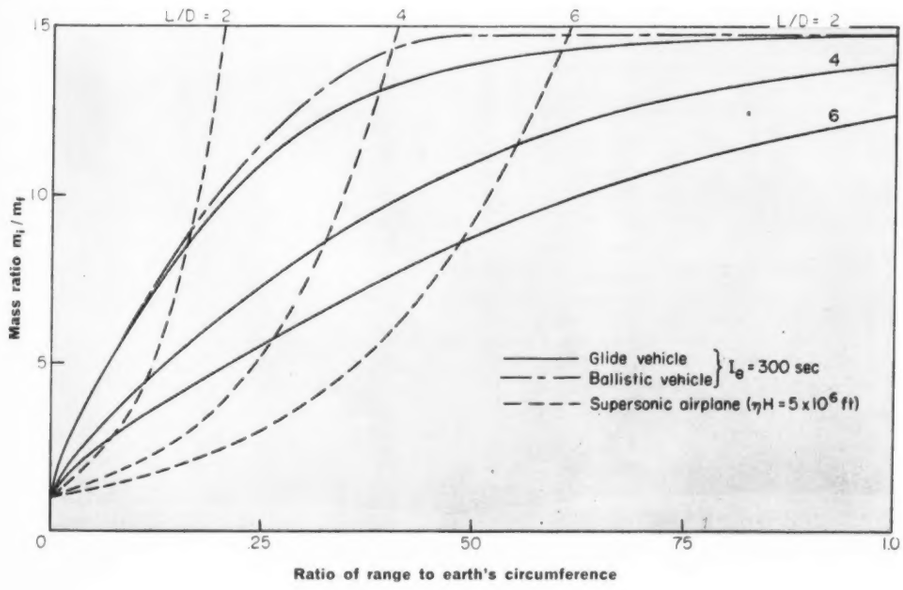


Fig. 2: Mass ratios for three categories of vehicle plotted against range (abscissa) and lift-drag ratio (parameter).
It should be noted that the specific impulse of 300 sec assumed in the first two cases would apply only to a very efficient rocket booster and that the Breguet range equation used for the supersonic aircraft assumes a very favourable value for H, such as could be obtained only with a highly efficient air-breathing engine.

[1] Hypervelocities in the sense of this article are a major fraction of satellite speed.

[2] Cf. Sänger, Eugen: "Raketenflugtechnik" (R. Oldenbourg, Berlin, 1933); E. Sänger and I. Bredt: "A Rocket Drive for Long-Range Bombers" (Technical Information Branch, Navy Department, Trans. CGD-32, 1944); also E. Sänger: "The Prospects of Jet Reaction Flight" in *Interavia*, No. 11, 1948, pp. 617–622.

[3] Eggers, Alfred J., Jr., Allen, H. Julian, and Neice, Stanford E.: "A Comparative Analysis of the Performance of Long-Range Hypervelocity Vehicles" (NACA TN 4046, October 1957).

[4] Allen, H. Julian, and Eggers, A. J., Jr.: "A Study of the Motion and Aerodynamic Heating of Missiles Entering the Earth's Atmosphere at High Supersonic Speeds" (NACA TN 4047, 1957; supersedes NACA RM A53D28).

(see *Fig. 1*) and decreased deceleration. It is not obvious from these relations, however, under what circumstances this advantage becomes the dominant factor in glider performance and this is the matter we will now explore.

We will take the point of view that the performance of a hypervelocity glider is measured by its *efficiency of flight*. The efficiency of flight is perhaps best measured by the cost of delivering a given payload a given range—the higher the cost, the lower the efficiency. Quite obviously it is far beyond the scope of this article to compute costs. We will therefore adopt a more accessible parameter of hypervelocity flight, namely the *initial mass of the vehicle as a measure of cost*. In effect then, the assumption is made that the higher the initial mass of the vehicle for a given payload, the higher the cost and the lower the efficiency.

With these thoughts in mind we will employ the basic performance equation for rocket boosters

$$\ln \frac{m_i}{m_f} = \frac{v_s \cdot v_f}{g \cdot I_e} \tag{3}$$

where:

g = gravity acceleration,
I_e = the effective specific impulse of the rocket booster,
v_s = satellite speed,
m_i = the initial mass of the vehicle at launch,
m_f = the mass in unpowered flight.

With the aid of this equation and equation (1) we obtain the mass ratios as a function of range shown on *figure 2* for gliders having different lift-drag ratios. Similar results are shown for a ballistic vehicle and for a supersonic airplane.

It is evident that for ranges up to a sizable fraction of the circumference of the earth, lift-drag ratio has a powerful effect to reduce mass ratio and hence increase flight efficiency of the glider. On the other hand, as range approaches the global value ($\varphi = 1$), lift-drag ratio becomes a relatively weak factor in determining the mass ratio of the glider. This situation results because glider velocity approaches satellite velocity where centrifugal force becomes the predominant factor in supporting the weight of the vehicle—so predominant, in fact, that there is relatively little to choose between the glider and the ballistic vehicle in terms of mass ratios required for global range flight.

For shorter range flight it is instructive to compare the mass ratios of the boost glider with those of the supersonic airplane. We see that depending on L/D these ratios compare favorably at ranges from 1/6 to 1/2 the circumference of the earth, and at ranges in excess of semi-global the glider tends to have lower mass ratios for all of the values of L/D considered. Accordingly, it is suggested that the hypervelocity glider may be a relatively efficient as well as fast carrier over long ranges.

This is not a well-defined possibility at the present stage of our thinking, however, because it was deduced from considerations of m_i as it relates to m_f rather than m_p, *the mass of payload,* which we agreed would be the fixed or given quantity. In order to relate m_i and m_p we must know both m_i/m_f and m_s/m_p, thus

$$\frac{m_i}{m_p} = \frac{m_i}{m_f}\left(1 + \frac{m_s}{m_p}\right) \tag{4}$$

where m_s is the mass of the glider structure which is taken here to include everything but payload. Now, quite obviously, the lower the value of m_s for a given payload, the lower the value of m_i and the higher the performance efficiency of the vehicle as we have defined it.

*

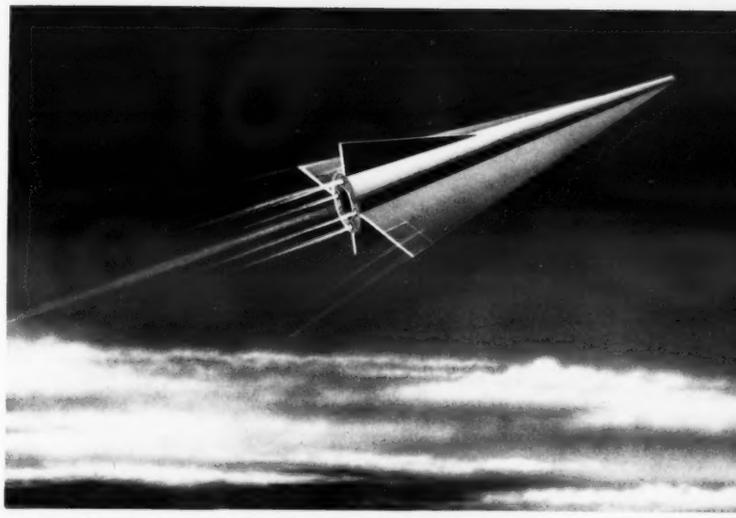
Probably the biggest single factor which increases structural mass of a hypervelocity glider (or any other hypervelocity vehicle) is aerodynamic heating, and so it is appropriate that we explore the possibilities of minimizing this heating. For this purpose it will be instructive to study the convective heating equations:

For *total heat transfer:*

$$Q = (KE)_f \frac{1}{2} \frac{C'_F S}{C_D A} \tag{5}$$

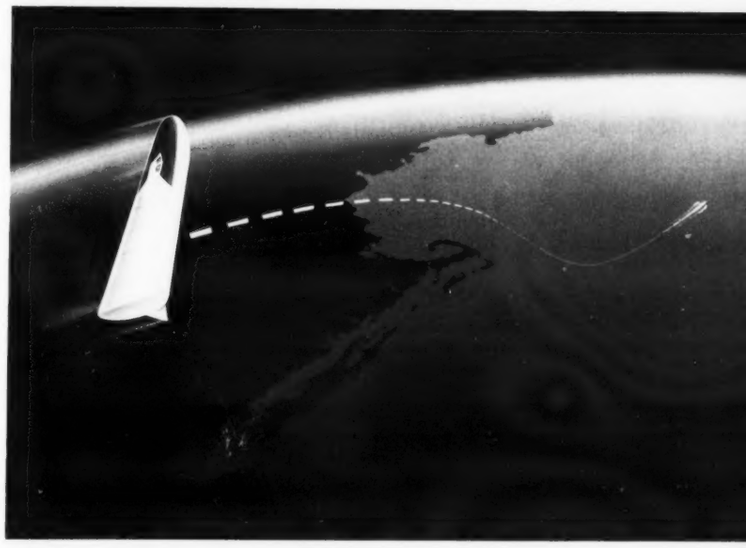
for *average heat transfer rate:*

$$\frac{d H_m}{d t} = \frac{1}{4} \rho v^3 C'_F \tag{6}$$



Drawing of a rocket-boosted hypersonic glider of high lift-drag ratio.

Drawing of a rocket-boosted ballistic vehicle for global ranges, in the descent phase: the delta-shaped vehicle is shown with a high angle of attack, as the maximum lift is to be used for braking. Later the angle of attack can be reduced, so as to obtain better lift-drag ratios and controllability of the glide angle. Finally the vehicle comes down on the water—in this picture on the Atlantic northeast of New York.



and for *stagnation-point heat transfer rate:*

$$\frac{d H_{st}}{d t} = \text{const.} \sqrt{\frac{\rho}{\sigma}}\, v^3 \tag{7}$$

where C'_F is an equivalent skin friction coefficient, σ is the radius of curvature of the surface at the stagnation point, *KE* is kinetic energy, and the remaining symbols have their usual meaning.

According to equation (5) total heat transfer can be reduced *by reducing the ratio of friction drag to total drag,* and this is readily achieved by employing blunt, high-drag shapes.[4] But such shapes tend also to develop very low lift-drag ratios which, as we have seen, generally depreciate gliding efficiency to an unattractively low level. If slender shapes are employed to obtain higher lift-drag ratios, total heat transfer becomes very large indeed. It may, for example, exceed 10 percent of the kinetic energy of the vehicle, which would pose a prohibitive heat absorption problem even if the entire vehicle were coolant. So it is necessary to *radiate the large majority of this heat away from the glider* in order to minimize coolant and hence structural weight. Radiation cooling is attractive providing convective heating rates are not so high as to require impractically high surface temperatures. We see from equations (6) and (7) that both average and stagnation-point heating rates are reduced by reducing the density of the air through which the glider is flying at a given speed. It follows that surface temperatures should be reduced by increasing flight alti-

tudes and this can be achieved by *reducing the wing loading of the vehicle.*

We note further that stagnation-point heating rates are reduced by making the *radius of curvature of the surface* in this region *as large as possible,* consistent with the lift-drag ratio requirements. In the case of a body of revolution the nose can be rounded substantially[5] without significantly reducing lift-drag ratio. In the case of a wing, however, even small rounding of the nose or leading edge can have a pronounced tendency to decrease lift-drag ratio because of the increased pressure drag.

Studies[3] have indicated that sweeping the leading edge will markedly reduce the drag penalty and will reduce heat transfer rate to the leading edge as well. Accordingly, a hypersonic glider capable of developing reasonably high lift-drag ratios and designed at the same time to minimize aerodynamic heating problems might appear something like that shown on *figure 3.* It has a low-aspect-ratio delta wing which should permit reduced wing weights and hence reduced wing loading. This configuration is also compatible with the use of high wing-leading-edge sweep to reduce heating rates in that region. The vertical fins also have the delta configuration and their edges along with the nose of the body are blunted.

If wing loadings are in the range of 20—30 lb./sq.ft., maximum average surface temperatures should be of the order of 2,000°F and possibly somewhat less depending upon the amount of laminar flow over the vehicle. These temperatures are well within the range of useful strengths of known structural materials including the molybdenum base alloys.[6] Nose and leading edge temperatures will in all probability exceed these values and ceramic materials may therefore be required in these regions.

It is never possible, of course, to build a perfect *radiation shield.* There is always a certain amount of heat which "leaks" through the shield to the internal structure. As the duration of flight increases, this *heat leakage problem* can assume major proportions if substantially more structure is required to absorb the heat. If, at the same time, the action of aerodynamic forces has, at best, a minor influence on range, then the high lift-drag ratio glider may cease to be an attractive machine.

As we approach *global* range flight exactly these two factors come into play. That is, flight time becomes relatively long (of the order of an hour and a half or more) with the attendant increase in seriousness of the heat leakage problem, while lift-drag ratio assumes a relatively minor role in terms of performance efficiency (see *Fig. 2*).

*

Accordingly, an attractive global glider concept may be one in which *the vehicle is launched into a low altitude satellite orbit* which it follows over the large majority of its range. It enters the atmosphere in the terminal phase of flight to glide the short remaining distance to its landing point. Under these circumstances, the vehicle may be designed to minimize aerodynamic heating during atmospheric entry, and for this purpose we are attracted to the use of high lift[7] as well as low wing loading to reduce heating rates and surface temperatures.

The vehicle may glide into the atmosphere at the high angle of attack for maximum lift coefficient, maintaining this attitude until speed has been reduced to a supersonic value where heating has become a relatively minor problem. The angle of attack may then be reduced to increase L/D, thereby extending the glide and increasing maneuverability to achieve the desired landing point. For this type of application the vehicle might have more of the appearance shown on *figure 4,* again being of the delta wing planform but having a more or less rounded bottom to minimize heating rates over the leading edge as well as the entire lower surface during re-entry. Such a configuration bears a marked resemblance to a motorboat and it might in fact be well suited for landing on water as shown.

[5] Eggers, A. J., Jr., Dennis, David H., and Resnikoff, Meyer M.: "Bodies of Revolution for Minimum Drag at High Supersonic Airspeeds" (NACA RM A51K27, 1952).

[6] Batdorf, Samuel B.: "Structural Problems in Hypersonic Flight" ("Jet Propulsion," Vol. 27, No. 11, November 1957, pp. 1157—1161).

[7] High lift tends, of course, to mean increased decelerations because of reduced L/D during atmospheric entry; however, even for L/Ds of the order of unity these decelerations remain modest (see equation 2) and they should not, therefore, constitute a serious piloting problem.

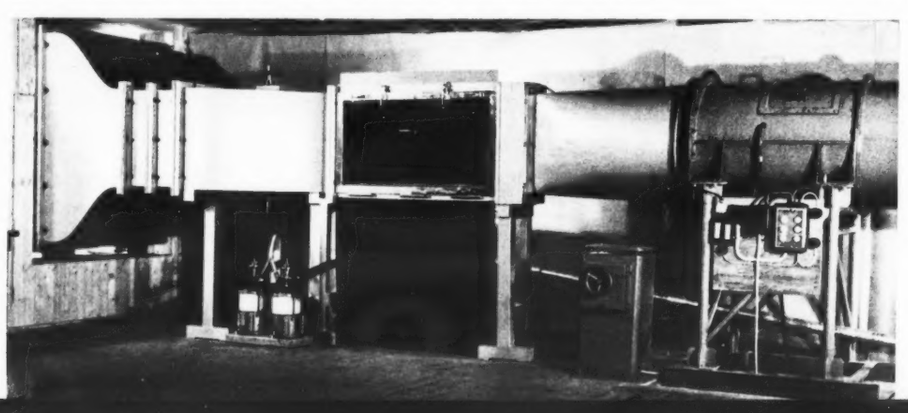
Recent Products of the Equipment Industry

● **Hartmann & Co.** at Ravensburg (Württemberg) in West Germany is currently producing HACO smoke tunnels of various types. The production programme includes the Standard model, designed mainly for instructional and laboratory uses. This tunnel has a total weight of only 62 lb. and offers a test chamber 20 7/8 in. long by 11 3/8 in. high by 1 3/16 in. deep. Air flow speed up to 8.2 f.p.s.; smoke stream separation 3/8 in.; power supply 220 V AC; consumption 270 watts.

For special research projects Hartmann & Co. is also producing a large smoke tunnel (see lower picture) with variable smoke stream speeds up to 115 f.p.s. The test chamber of this equipment is 55 in. long by 27½ in. high by 10 in. deep. These smoke tunnels permit direct observation of flow, and the external controls permit the attitude of the test piece to be changed at will. Additionally it is possible to vary the flow speed during the actual experiment (variation of motor speed), and the density of the smoke channels can be varied by adjustment of the smoke jets. Finally by means of a fine control, the smoke jet rack can be raised or lowered in order that

a particular smoke stream can be directed on to a given section of the test piece.

Other structural details are: equipped with electrically heated continuous operation smoke producing unit; time phased cut-off of the smoke stream is possible for specific experiments; special illumination of the test chamber, etc.



● After many years research, **United States Radium Corporation**, of Morristown, New Jersey, has developed a series of lamps and markers which use phosphor, excited by means of radioisotopes (Krypton or tritium), as source of light. The lamps —trade name "Isolite"—emit constant-intensity light uninterruptedly for up to 25 years, without any kind of maintenance or power supply. One example of this range, pictured herewith, is a runway marker lamp, which can be seen from any angle.

● **Reliance Manufacturing Co.** has announced that its subsidiary, **Pioneer Parachute Co.,** of Manchester, Conn., will shortly produce a new rotating parachute for military paratroop and air cargo drop operations (pictures), for missile and target drone recovery, and for ground braking of high-speed aircraft. The new parachute was designed by David T. Barish, and developed and patented with financial assistance supplied by Laurance S. Rockefeller. Pioneer will produce and market the new parachute under an exclusive licencing agreement with Barish, who will serve as consultant to the company. Evaluation and service tests of the parachute are now being conducted by the USAF, the U.S. Army, U.S. Navy, and the Marine Corps and two manufacturers of jet aircraft. Tests already carried out have indicated that the Vortex Ring parachute, as it is known officially, has excellent inherent stability, low shock effect on opening and virtually no oscillation. It features less bulk and weight than an equivalent conventional parachute, but is said to have twice the drag. Furthermore such a parachute opens as quickly as the best of conventional designs, and it reportedly collapses on the ground more readily.

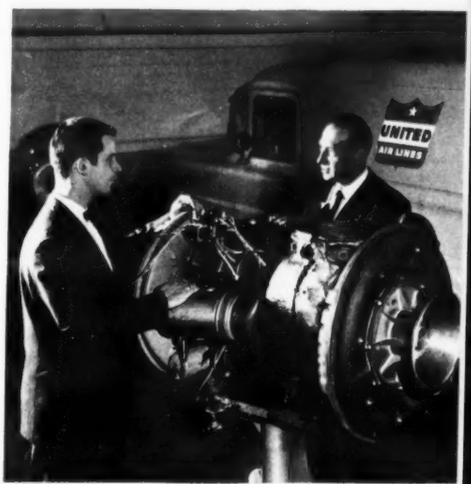
● **Linde Company**, a **Division of Union Carbide Corp.,** announces the development and production of a new model HP-8 immersion pump for delivering liquid nitrogen and oxygen at high pressures. The HP-8 can deliver 11,000 cu.ft. of nitrogen per hour and oxygen at a rate of 13,750 cu.ft. per hour at 10,000 p.s.i. Drive for the pump is a 15 h.p., 550 Volt, 60 cycle AC motor.

● **Hamilton Standard**, a Division of United Aircraft Corp., is to design, develop and manufacture a system to control the position of shock waves in the engine air inlets of the North American B-70 *Valkyrie* bomber, under a new multi-million dollar contract. This hydraulic-mechanical system will change the shape and size of the air inlets so as to control the shock wave position and provide the proper amount of air to the engine.

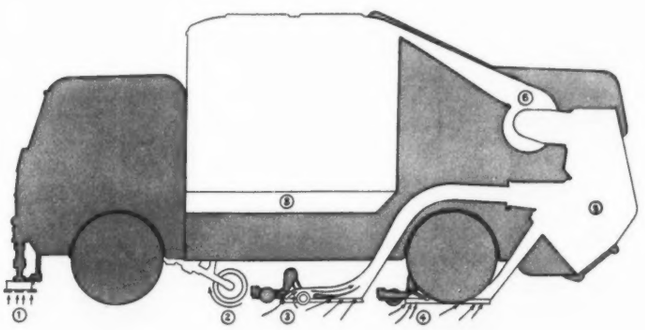
● **Lockwood, Kessler & Bartlett Inc.,** of Syosset, N.Y., a company specializing in aerial mapping, has developed an aerial photogrammetry technique for taking inventory of coal, sand, gravel and other bulk materials stored in the open.

● United Air Lines has recently placed an initial order for seven of the illustrated Turbo Starters from the **Industrial Products Division** of the **Boeing Airplane Company** in Seattle, Wash. UAL has also taken an option on a further fifty units. The starters, which are powered by a Boeing 502-11B gas turbine compressor, deliver low-pressure, high-flow hot air, and can be used not only to start jet engines but also to "windmill" engines for maintenance work, to check air conditioning and pressurization systems, and remove ice and snow from parked aircraft. They will be mounted on panel trucks; first delivery to UAL began in December 1958.

The Boeing 502 series of gas turbines have been in production at the Industrial Products Division for some years and are used for a wide variety of industrial applications (e.g., to power boats, trucks, emergency power supply, etc.). The 502-11B model used in the starter units ordered by UAL has a power of 205 h.p. at 36,000 r.p.m.; dimensions roughly 28.5 × 27 in.; length 50 in.; installed weight 375 lb.; compressed air delivery approx. 2.1 lb./sec at 57 p.s.i.

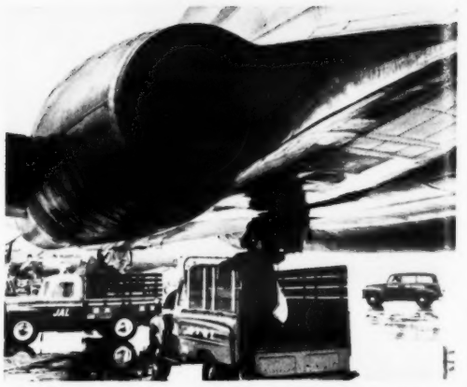


● **Belotti**, of Genoa, has added a new member to its family of runway and taxiway sweepers, in the shape of the Model B/5, which is designed for use by both military and civil authorities. The B/5 unit is mounted on a Fiat 642/N6 commercial-type chassis which is powered by a 6-cylinder 4-stroke 90 h.p. diesel engine. The sweeper unit includes the following main parts: a sweeping assembly which consists of three special independent suction nozzles; shape of the nozzles is such that they can match any kind of surface profile and thoroughly clean all surface cracks; a heavy materials hopper and a dust hopper, the first being divided into three separate compartments, one for each suction nozzle; a single handle actuated lever for main hopper discharge. The B/5 equipment also features: special dry air filter; three centrifugal exhausters; auxiliary power unit, etc. As optional equipment a special roller for dried mud scraping and removal is offered, as well as a 1.5 kW electromagnet to remove such items as bomb splinters, etc. Main data: overall length 24′ 7″; overall width 8′ 2″; max. height 11′; sweeping swath 8′ 2″; sweeping speed up to 28 m.p.h.; max. travelling speed 38 m.p.h.; weight empty 9.5 tons. Figures in operating systems diagram: 1. electromagnet; 2. scraping rollers; 3. side floating suction nozzles; 4. central floating suction nozzles; 5. main hopper; 6. centrifugal exhausters; 7. large surface air filters; 8. dust and sand hopper.



What's in the Air?

Extracts from Interavia Air Letter, *daily international news digest, in English, French and German. All rights reserved.*



Loading mail and luggage into the fuselage of a Russian Tupolev Tu-104A jet aircraft at the Tokyo International Airport.

Japan's Fuji T1F2 two-seat jet trainer.

The four-seat Fuji KM-1 communications aircraft, which is due to commence flight testing in the near future.

AIR TRANSPORTATION

● **British European Airways** has written a letter of intent to The Fairey Aviation Company informing the latter that an order will probably be placed for six of a developed version of the *Rotodyne* VTOL airliner; a firm order depends on the provision that the *Rotodyne* meets all BEA requirements. According to *Interavia's* London Correspondent, BEA is considering the 65-seater with Rolls-Royce *Tynes*, but the initial order is likely to be for the 48-seater *Eland*-powered aircraft (with an option on the *Tyne*-powered version).

● **Northwest Airlines** has placed a $29,654,000 order with Lockheed Aircraft Corporation for ten *Electra* turboprop airliners and spares, with an option for another two of these aircraft. Northwest has also ordered five extended-range Douglas DC-8s with an option for an additional four.

According to Donald W. Nyrop, Northwest President, the company's *Electras* will be fitted with wing fillet tanks which will increase fuel capacity to a total of 6,420 gallons, giving the aircraft transcontinental range. Deliveries will begin in July 1959 and will be completed in December 1959.

● **Northwest Airlines** reported an all-time profit and revenue record in 1958. Revenue totalled $101,283,000, a 21 percent increase over the previous record of $83,432,000 set in 1957; net profits totalled $5,501,000, or $3.98 a share, compared with $4,819,000 or $3.56 a share in 1957.

● **Pan American World Airways** carried 300,771 passengers across the Atlantic Ocean in 1958, an increase of 6.6 percent over a year ago. Daily PAA Boeing 707 services from New York to Paris were inaugurated in late October, and to London in mid-November. By the end of the year, a total of 19,557 passengers had flown on the transatlantic services in the Boeing 707.

● **Flying Tiger Line** has asked the U.S. Civil Aeronautics Board for permission to operate the first all-cargo route across the Pacific. The cargo route between the co-terminal points of San Francisco and Los Angeles and Tokyo and Manila would also include calls at Hawaii, Wake Island, Guam, Formosa and Hong Kong. Lockheed L-1049H Super Constellations would be used. The company also filed an accompanying petition requesting interim permission to conduct limited flights (fifteen a month) on the route pending a final CAB decision.

● **Scandinavian Airlines System** has placed an order with Redifon Ltd. of Crawley, Sussex, for a *Caravelle* flight simulator. The simulator will be housed at Bromma Airport, Stockholm.

INDUSTRIAL

● **Northrop Aircraft Inc.** changed its name to Northrop Corporation on February 2nd. At the same time, the company's Northrop Division at Haw-

The International Aviation Fuelling Service of the British Petroleum Co. has been operating under the name "Air BP" since January 1st, 1959. At the same time, the service's double wing symbol was replaced by a new symbol comprising the familiar green and yellow BP shield flanked by a single red wing.

The Nardi FN.333 four-seat touring amphibian with 240-h.p. Continental 0-470-H engine driving a Hartzell two-blade variable pitch pusher propeller. The FN.333 was recently granted type certification, and Nardi S.A. per Costruzioni Aeronautiche, of Milan, has now commenced construction of a batch of 25 of these aircraft.

The Finnish Air Force has ordered 20 Swedish Saab-91D Safir *trainers, the first of which* (picture) *was delivered at the end of 1958.*

The Swedish Defence Ministry has decided to purchase ten Sud-Aviation Alouette II *jet helicopters; eight will go to the Navy and two to the Air Force.*

A Fairey Rotodyne *VTOL passenger transport (2× Napier* Elands *each of 2,800 h. p.) set up a new speed record of approx. 190.9 m. p. h. for rotary-wing aircraft on January 5th, 1959, over a closed 100 km circuit at Maidenhead. The pilot was Squadron Leader W. Gellatly (below). This record will be submitted to the FAI for homologation. The previous record of 141.9 m. p. h. was set up by a Sikorsky H-34 helicopter in July 1956.*

thorne, Calif., took on the new name of Norair. According to an announcement by Whitley C. Collins, Northrop President, the new corporate name is in line with the company's broadened scope of operations which includes guided missiles, target drones, space research projects, and electronic, electromechanical and optomechanical products as well as aircraft. Norair's main task will continue to be the development and production of high performance aircraft and missiles.

● **The Guided Missiles Division** of Republic Aviation has been renamed Missile Systems Division. Formed in 1952, the Division is located in three plants on Long Island, and is currently producing surveillance drones for the Army Signal Corps and nose cone structural units for the *Atlas* and *Thor* missiles.

● **Data Graphic Systems Inc.** is a new corporation which has been formed jointly by Douglas Aircraft Co. and General Aniline & Film Corporation. It will be engaged in the development of new systems in the microfilm and reproduction fields. Walter A. Hensel has been elected President; Vice President and General Manager is Russell S. Ellsworth (formerly of the Ozalid Division of General Aniline); Francis Nivens and J. Edwin Coates, both of Douglas, are Vice Presidents; James T. McMillan (Douglas) is Secretary and Treasurer.

● **Thiokol Chemical Corporation** has received a multi-million dollar subcontract from Goodyear Aircraft Corporation for the design and development of the propellant portion of the propulsion system for Subroc, the new anti-submarine missile system now under development for the Naval Bureau of Ordnance. The Subroc system is designed to detect a submarine at long range, compute its course and speed, and fire the missile from a position either above or below the surface. Goodyear is charged with design and development of the propulsion system.

● **Lockheed Aircraft Corporation's** Georgia Division at Marietta has been awarded a multi-million dollar contract to build aft fuselage sections for the North American B-70 *Valkyrie* bomber. The manufacturing programme on these sections will extend over several years.

● **The U.S. Navy** has awarded contracts for approximately $35 million to Sikorsky Aircraft Division of United Aircraft Corporation for further production of the Navy and Marine Corps versions of the single-engine S-58 helicopter and spare parts. More than 1,000 military and commercial models of the S-58 have been built since production started in 1954.

● **Jarry Hydraulics,** formerly a division of Jarry Automobile Ltd. of Montreal, has been incorporated as Jarry Hydraulics Ltd. The company is one of Canada's foremost designers and manufacturers of aircraft hydraulic systems and landing gear. Fernand Jarry is President of the new company. Adalbert Jarry becomes Senior Vice President in charge of finance; Leo Vadeboncoeur, Vice President—General Manager; John Truran, Vice President and Director of Engineering and Sales; Lucien Desnoyers is Secretary and Treasurer.

● **National Aeronautical Establishment** is a new air division of the National Research Council, Ottawa, to work on defence and civil aeronautical problems. The division has a flight research hangar and a new

supersonic wind tunnel at Uplands Airport, and an aerodynamics and structure laboratory in Ottawa. Acting Director of the National Aeronautical Establishment will be Frank R. Thurston.

● **Nord-Aviation** has received orders from the French armed forces for a total of 350 Nord CT.20 target drones powered by Turboméca *Marboré* turbojets. Several foreign countries are reportedly interested in the drone, and various contracts are under negotiation.

MILITARY AFFAIRS

● **The British Government** has awarded the contract for the new RAF light bomber jointly to Vickers and English Electric, with Vickers as the main contractor. The engine will be produced by Bristol Siddeley. Estimates of the price of the development contract vary between £35 million and £50 million.

To be known as the TSR.2 (tactical support and strike reconnaissance), the new aircraft will be far more advanced than the original plan, i.e. general operational requirement 339. The RAF intends to use it as a tactical attack aircraft with conventional weapons; atomic precision bomber; high altitude reconnaissance aircraft; and probably high altitude weapons platform and jammer.

A very long development life is anticipated, and by the 1970s the TSR.2 may well be VTO, using some SC.1 techniques. In its straight form for the RAF, it will be STOL and capable of using short, rough runways.

On the engine side, the bitter fight between the RB.142 and the *Olympus* has now been decided. Bristol-Siddeley will develop the *Olympus* for the TSR.2, and in this connection a BE.15R variant has been mentioned.

● **The Ministry of Defence** has announced that the military version of the Armstrong Whitworth *Argosy* would be ordered for Transport Command of the Royal Air Force to extend Army mobility. The military version will be the AW.660, with four *Dart RDa.6* engines and a beaver tail incorporating rear loading door and integral ramp.

No details of the order have been given, but it is understood that the present contract will be for 25 to 30, with later additional orders up to 50 aircraft or more. Cost of the 660 would be approximately £500,000 apiece, and with spares the initial order represents about £15 million.

● **About one dozen U.S. companies** are competing for a USAF contract to develop an Airborne Early Warning and Control aircraft (AEW & C). The aircraft would have to have an altitude capability of 25,000 ft. to 30,000 ft., and the ability to cruise during eight hours at a distance of 1,000 miles from its home base. It is understood that sufficient funds will be provided in the USAF budget to start the programme

The first Convair 880 jet liner was rolled out two weeks ahead of schedule on December 15th, 1958; nine days later the second 880 was completed. Seven further aircraft are at the final assembly stage.

next year, and that a contract will be awarded about mid-February.

AICRAFT AND POWERPLANTS

● **A new "N" version** of the Fiat G.91 light strike fighter, destined for testing various air navigation equipment, has now been mentioned for the first time. Fiat also announces that the G.91R air photography and reconnaissance version is now undergoing operational testing.

● **The prototype of the Max Holste MH.250 Super Broussard** is now approaching completion at Holste's Reims plant, and the aircraft is expected to make its first flight within a few days. While the first prototype (MH.250-01) is provisionally powered by Pratt & Whitney R-1340 600-h.p. piston engines, MH.250-02, which is now in assembly, will be powered by Turboméca *Bastan* propeller turbine units. The MH.250 will have a 17—20 passenger cabin layout and is designed to operate over stages of 810 nautical miles.

France's Nord-Aviation Nord 3202 two-seat trainer, powered by a 240-h. p. Potez 4D32. Production of this aircraft is just starting up.

● **Société Potez** has now commenced production of a batch of 376 4D30 and 4D32 4-cylinder in-line engines, following the award of a French Government contract. The 240-h.p. 4D30 fitted with supercharger, which will be redesignated 4B34 after certification at 260 h.p., is scheduled to equip the three-seat Nord 3400. The 240-h.p. 4D32, also with supercharger, is planned to power the Nord 3202 two-seat trainer, and special attention has been paid to providing the possibility of unlimited aerobatic airworthiness.

● **The Turboméca Bastan propeller turbine engine** has been submitted to a total of 150 hours certification tests, broken down into a series of 25 six-hour runs. During these official tests the unit's performance under normal take-off conditions and at 33,500 r.p.m. was as follows: shaft power 750 h.p.; residual thrust 146 lb.; hourly consumption 518 lb; equivalent specific consumption 0.64 lb./h.p./hr.

● **The Beechcraft** now undergoing testing equipped with two Turboméca *Bastan* propeller turbine power units has logged 45 hours flying time. Flight testing at CEV Marignane which commenced on September 19th, 1958, will shortly be completed.

● **The Cessna Military Division,** in Wichita, has for some time been concerned with the development of an improved version of the YH-41 *Seneca* helicopter for the U.S. Army. The improved version incorporates many improvements including increased flight stability, increased payload and simplified maintenance. The developed version of the YH-41 has been delivered to the U.S. Army's Aviation Center for extensive CAA evaluation trials.

On December 17th, 1958, flight tests commenced on the second prototype of the Handley Page Dart-Herald *at the Woodley airport near Reading. According to reports from London, the Australian Air Force is showing increased interest in this aircraft, as a DC-3 replacement.*

● **Chance Vought's** $4 million high-speed wind tunnel has now started operation, and 500 test and calibration runs already have been carried out. This new tunnel is of the straight-through, blowdown type, and features a variable four-foot test section. Designed for speeds up to Mach 5, the tunnel's capacity could be expanded to run tests up to Mach 10.

● **The twin-engined YS-11** short/medium-range passenger transport (2 × Rolls-Royce *Dart RDa.10*) is being developed by a consortium of six of Japan's leading aircraft firms (Mitsubishi Heavy Industries, Kawasaki, Fuji Heavy Industries, Japan Aircraft, Showa Aircraft and Shin Meiwa); the aircraft will be produced by a new joint company whose title has not yet been registered. Reports from Tokyo state that provisionally it is planned to build two prototypes of the YS-11 scheduled for completion at the end of 1961 and for flight testing in 1962. Quantity production could commence in 1963-64. The available technical data are: span 105 ft.; length 87 ft.; wing area 1,023 sq.ft.; aspect ratio 10.8; take-off weight 49,600 lb.; useful load 11,900 lb.; crusing speed 280 knots at 20,000 ft.; passenger capacity 40 to 60 over respective ranges of approx. 1,270 or 590 nautical miles.

● **The Nord 3202 two-seat trainer** has now been put into quantity production and a first batch of 100 aircraft has been ordered for training French Army pilots. Some technical details of the aircraft are: Design: low-wing monoplane; thickness/chord ratio 17% at wing roots and 12% at wing tips; dihedral 7°; single spar wing; fuselage of tubular steel skeleton with metal skin; tail unit structure in light-metal alloy, fabric covered; fixed tail-wheel undercarriage with oleo-pneumatic shock absorbers; hydraulic brakes. Powerplant: One Potez 4D32 of 240 h.p. with supercharger and equipped for aerobatic flying; Ratier variable pitch propeller; fuel capacity 43 Imp. gals; lubricant 3.3 Imp. gals. Characteristics and performance: span 31.17 ft.; length 26.64 ft.; height 9.25 ft.; wing area 175.02 sq.ft.; aspect ratio 5.5; take-off weight 2,690 lb.; max. speed 162 m.p.h.; cruising speed 155 m.p.h. at 4,265 ft., or 146 m.p.h. at 7,545 ft.; rate of climb at sea level 1,182 f.p.s.; range 620 miles.

● **The first of twenty Britannia 253 transports** on order for RAF Transport Command commenced flight testing on December 29th, 1958. Fifteen will be built at Short Brothers and Harland Ltd.'s Belfast plant. Components for the remaining five aircraft, to be constructed by Bristol at Filton, will also be manufactured in Belfast. Destined for troop transportation (115 soldiers), freight and air ambulance duties, the aircraft are powered by Bristol *Proteus 255* turboprop engines, each of 4,445 e.s.h.p. (the *Proteus 255* has a water injection system). The freighter version can transport loads of up to 16 tons over distances of 4,100 miles at a speed of 400 m.p.h.

● **The Hawker Siddeley Group** announced on January 9th, 1959, that it intended to go ahead with the construction of the private venture Avro 748 short and medium-range 36—44 seat passenger transport. This brings the total of private venture transports under development in the United Kingdom up to five (the others are DH.121, *Argosy*, *Vanguard*, and VC.10). The Avro 748 will be a simple, rugged construction all-metal machine with two *Dart RDa.6* turboprops mounted on the low wing. Take-off weight is likely to be a little over 30,000 lb.; max. payload 7,550 lb.; cruising speed approx. 280 m.p.h. The 748 will be able to use any of the airfields at present being used by DC-3s, and Fowler flaps will assist airfield performance. The *Dart* installation is intended to provide interchangeability with present *Viscount* units, and it will be mounted above the wing in a similar position to that on the *Accountant*, to give easy accessibility, short undercarriage and avoid major spar cut-outs. A freight door will be provided, large enough to load a *Dart* engine, giving the aircraft a dual role as passenger and freight transport. The Hawker Siddeley Group states that first flight target date is early 1960.

Five UF-2 Albatross *amphibian multi-purpose aircraft are at present in production at the Grumman Aircraft and Engineering Corporation plant.*

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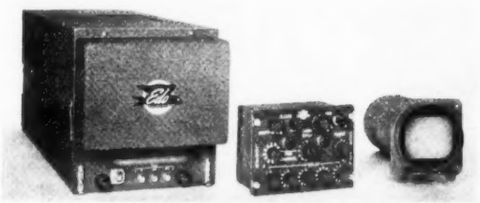

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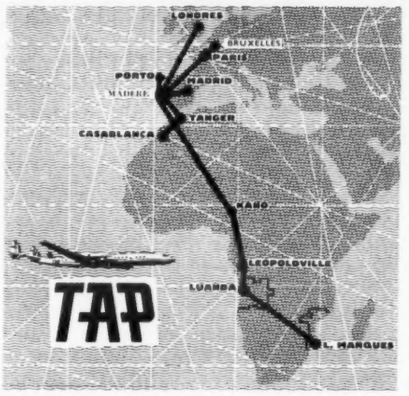

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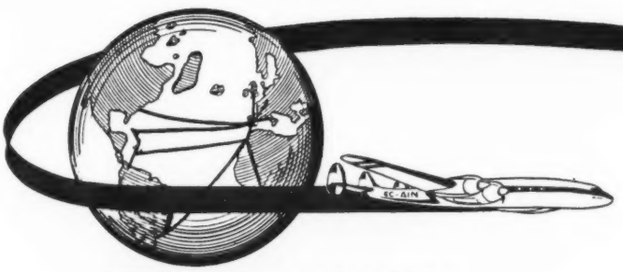

SERVICES LINKING
4 CONTINENTS

Iberia
LINEAS AEREAS ESPAÑOLAS

List of Advertisers in "Interavia" No. 2, 1959

Aero Design & Engineering Co., Oklahoma City . . . 140
Aircraft Radio Corp., Boonton . . . 183
Air France, Paris . . . 113
Alitalia, Rome . . . 132
Alvis Limited, Coventry . . . 127
Armstrong-Whitworth Aircraft Ltd., Baginton . . . 159
Atlas Copco A.B., Stockholm . . . 114

Bendix International, New York . . . 180, 181
Boeing Airplane Co., Seattle . . . 128
Bristol Aeroplane Co. Ltd., Bristol . . 110, 111
British Petroleum Co., London . . . 162

Canadair Limited, Montreal . . . 161
Collins Radio Co., Cedar Rapids . . . 179
Contraves Italiana S. p. A., Rome . . . 160
Convair, San Diego . . . 200
Costruzioni Aeronautiche Giovanni Agusta, Cascina Costa (Gallarate) . . . 198

Marcel Dassault, Générale Aéronautique, Paris . . . 139
Decca Navigator Co., London . . . 117
Deutsche Lufthansa AG., Cologne . . . 132

Edo Corporation, New York . . . 195
El Al, Paris . . . 197
Electronic Associates Inc., Brussels . . . 122
English Electric Co. Ltd., London . . . 142
English Electric Co. Ltd., Aircraft Equipment, London . . . 184

Flug- und Fahrzeugwerke AG., Altenrhein 129

Gilfillan Bros., Los Angeles . . . 131
Grumman Aircraft Corp., Bethpage . . . 133

De Havilland Aircraft of Canada Ltd., Toronto . . . 182

Hunting Aircraft Ltd., Luton Airport . . 124

Iberia, Madrid . . . 197

KLM Royal Dutch Airlines, The Hague . 196

Lear Inc., Santa Monica . . . 186

Marconi's Wireless Telegraph Co., Chelmsford . . . 112
Minnesota Mining & Mfg. Co., St. Paul 141

D. Napier & Son Ltd., London . . . 118
National Aeronautical Corp., Teterboro . 196
Nord-Aviation, Châtillon s/Bagneux . . . 130
Northrop Aircraft Co., Hawthorne . . . 137

Orenda Engines Ltd., Malton, Ont. . . . 185

Philips Telecommunicatie Industrie N. V., Hilversum . . . 138
Pilatus Flugzeugwerke AG., Stans/NW . . 195
Piper Aircraft Corp., Lock Haven . . . 109

Redifon Ltd., Crawley . . . 135
Rolls-Royce Limited, Derby . . . 120, 121

Sabena, Brussels . . . 108
Clichés Schwitter S.A., Basle . . . 198
Scottish Aviation, Prestwick Aerodrome . 196
SNECMA, Paris . . . 134
Sud-Aviation, Paris . . . 136

Technocommerz G.m.b.H., Berlin . . . 199
Telefunken G.m.b.H., Berlin . . . 106
Texas Instruments Inc., Dallas . . . 119
Transportes Aereos Portugueses, Lisbon 197
Triplex, Longjumeau . . . 197

UAT, Paris . . . 107
United Aircraft Export Corp,. East Hartford 123

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